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Seek To Maintain Quality--I

Quantity Production in American Foundries Attended by Precautions To Insure High Quality—Responsibility Largely Transferred from Workmen to Executives and Engineers—Examples Given in Several Industries

BY H. COLE ESTEP

European Manager of THE FOUNDRY

IN EUROPEAN eyes *mass production* seems to be the chief characteristic of American industry, with emphasis on the number of articles made rather than their quality. It is only natural perhaps, when viewing modern manufacturing methods in which a huge volume of production is the most spectacular but by no means the most important feature, for some people to make mental, if not verbal reservations, as to the quality of the goods turned out. A large number of American engineering writers have laid great stress on the speed of present-day methods, at the same time explaining how most of the operations can be entrusted to what is termed *unskilled* labor. In view of this it is not surprising to find in many quarters an impression that the goal of the average manufacturer in the United States is quantity, and quantity only.

Now the aim of the American manufacturer is decidedly for

Paper read before the Yorkshire branch of the Institution of British Foundrymen, at Leeds, England, Nov. 25, 1922.

AMERICAN CAST-IRON CAR WHEELS FORM AN EXCELLENT QUALITY MATERIAL PRODUCED UNDER QUANTITY PRODUCTION CONDITIONS—THIS ILLUSTRATION SHOWS THE LAYOUT OF PART OF A DAY'S OUTPUT IN AN AMERICAN WHEEL FOUNDRY—PATTERNS ARE CAREFULLY MADE AND FITTED TO THE FLASKS

quantity. But what the author of this paper hopes to point out is that back of this idea lies a definite conception of worth and also to show more or less clearly, especially as applied to the foundry business, that organization for a large output is worse than useless unless accompanied by an elaborate, carefully constructed, and constantly energized system of checks and control whereby it is made not probable but certain that the article manufactured, be it a casting or a shoelace, will meet certain predetermined standards. It is in these considerations, rather than mere volume, that the philosophy of modern manufacturing is found.

If we try to trace this philosophy back to its source, we find that the somewhat different conceptions of manufacturing which exist in Great Britain and the United States are due, not to material considerations, but to differences in mental attitude, and if we each can only seek to understand these intangible factors, we shall appreciate each other's problems more thoroughly and thus at one stroke contribute something not only to the progress of engineering but to the comity of nations.

ONE OF THE DETAILS OF CAR WHEEL MAKING—THE FLASKS ARE CAREFULLY FITTED AND EVERY CONVENIENCE IS PROVIDED TO AID PRODUCTION AND INSURE CASTINGS OF UNIFORMLY HIGH QUALITY

A Purely British Term

The term *mass production* is purely British in origin and use. It is seldom heard in American manufacturing circles. We on the other side of the Atlantic prefer to say *quantity production*—merely another way of saying the same thing, you may observe. Yes, practically, but not quite. There is a distinction between the two terms—one which finds its origin in the slightly different mental attitude of our two peoples toward manufacturing processes; and therefore an exact understanding of these two phrases may help to explain the psychology which has produced them.

In Webster we do not find *quantity* an a synonym of *mass*. *Mass* conveys the idea of a lump, in which the individual particles taken one by one are of no account, and are effective, impressive or useful only in the aggregate—in the mass. *Quantity*, on the other hand, means simply a collection of individual things; it involves the idea of number rather than of bulk, and under this conception the unit is of much more importance.

So perhaps with manufacturing. If a European foundryman is inclined to look on the casting of 2000 motor-car cylinder sets per day as *mass production*, his conception may not be quite the same as that of his American confrere who thinks of it as *quantity production* and knows that each casting must separately pass certain tests before it is acceptable for use, and must in service give 50,000 miles wear before requiring regrinding.

What the writer wants to try and make clear before taking up details connected directly with the foundry business, is that large output alone is only the first and in some aspects the least important step in quantity production. Insofar as this applies to the American foundry industry, it is found that its problems today are concerned not so much with increasing production as with the perfection of methods of control whereby the castings now being made will meet the most rigid specifications and satisfy the most exacting demands with the same uniformity as the more elementary requirements of interchangeability is fulfilled. Research and control are the two channels through which American manufacturers are striving to arrive at their true goal, which is the production of quality goods on a quantity basis.

Nor is this a question of ethics, for the adoption of high standards is necessary from business considerations. Under quantity production conditions the risk involved in turning out an inferior product is far greater than in the case of a small business, on account of the greater momentum of the large factory if for no other reason. A certain automobile company in the middle west of America was nearly ruined through turning out an inferior back axle for a single season. Examples of this sort could be multiplied. The necessity for giving constant thought to the kind of goods produced, if quantity manufacturing is to succeed, is made more clear by considering for a moment what modern output really means. To start with a basic commodity like pig iron, the American production of this metal at the present time is about two and a half million tons per month. In other words the output of the United States in nine or ten weeks is about the equivalent of that in Great Britain, under existing conditions, in a year.

Thousands of Tons Per Day

More spectacular is the production of the automobile industry. The average production of passenger cars so far this year has been 170,000 a month, or at the rate of a little over 2,000,000 cars a year. The lowest output, in January, was 70,000 cars, and the highest, in June, 263,000. To this must be added an average of 17,500 trucks per month, 5000 in January and 25,000 in June, making the total production of the country 288,000 vehicles in the latter month. Translated into foundry terms this latter output means 11,000 sets of cylinder castings per working day, together with an equal number of flywheels and transmission cases, about 60,000 pistons and 180,000 piston rings. This requires the melting and pouring of over 3000 tons of iron a day, and making the molds to pour it into.

Impressive as these figures are they represent only one branch of the American foundry business. Another branch, the cast-iron car wheel foundries, melts over 3500 tons a day. Equally large is the melt of those foundries connected with the heating, plumbing, steam and gas fitting trades. Among the steel foundries, we find one group of five shops delivering 2,569,327 castings to their customers in a single year, or about 1600 a day from each plant. The average weight of these castings was 17.29 pounds each. These figures are not presented with the idea of making any

comparisons with production elsewhere under totally different conditions but with the idea of suggesting the dimensions of the problem of control of quality under these circumstances.

Leaving aside the commercial aspects of the problem, we find that from the engineering standpoint quantity production is made possible, first by so subdividing operations that each step is made as simple as possible, secondly by providing machines wherever possible to take the place of hand labor, and finally by devising a system of control and inspection which will insure the work being turned out to predetermined standards. Of these three steps, the latter is perhaps the most important, but the first two have resulted in a complete change in the way the factor of human skill enters into the problem of production. This is a matter of no little moment.

The Subdivision of Labor

It is customary for those who take the position that modern high speed production implies a lowering of quality standards to point out that these methods have eliminated the skilled workman and annihilated craftsmanship, without which a superior product cannot be produced. This is not true. What quantity production has done is to change the way in which craftsmanship is applied to the job. In part, under the factory system, the responsibility for quality, which is the most that craftsmanship implies, is transferred to the engineer and the trained executive, while the workman instead of losing by this shift is left more free to specialize and to become truly skilled within his particular sphere.

In the foundry, to meet successfully the enormous demands of a twentieth century civilization, special methods involving radical departures from regular, traditional, or what might be termed orthodox practices, have had to be developed and introduced. Commenting on this, Pat Dwyer, engineering editor of THE FOUNDRY has said: "It was realized that the human factor could not be dispensed with altogether, but it was felt that by providing suitable mechanical equipment, the output from each operator could be tremendously increased without the slightest deterioration in quality. Furthermore, as the scope of mechanical equipment was extended it was found that the process of making molds could be divided into many elements and that each of these elementary operations could be performed by a separate workman. Therefore, in the United States, where formerly a period of four years was required to develop a molder competent to begin and finish his work, under the system now in vogue in specialty shops ordinary laborers can be taught in a few hours to fill any missing link in the long chain of production."

"This not only illustrates the flexibility of the quantity production system, but also goes to show that while molding skill, manual dexterity and mature judgment on the part of the workman are regarded as an important requirement in a jobbing shop, they are neither an asset nor a necessity in a specialty foundry. Power driven devices, accurate pattern and flask equipment and mechanical appliances for handling materials and making molds have reduced the personal element to a minimum and have placed the manufacture of certain classes of castings on a mechanically automatic basis. And in many cases, as has been demonstrated, the superior precision of the machine actually has resulted in both a more uniform and a better product than possibly could be produced by the most skilled molders and so-called old-time foundrymen."

But the necessity for a comprehensive and intimate knowledge of foundry practice is by no means eliminated under the quantity production system. It is simply transferred, from the many to the few. On those who remain the repositories of skill, judgment and knowledge, the burden of responsibility is enormously increased. It is the part of these leaders to synchronize and co-ordinate the efforts of the various operators, and to set high standards and see that they are maintained. But in a large shop a few such men can direct, vitalize and control a thousand workmen. Under this system the individual workman simply does one part of a job over and over again. Logically he does it as well if not better than a man who has to spread himself over many jobs. Under the quantity production system each operation is performed by an expert who soon develops far more skill than the best journeyman molder who tries to do everything. This tends strongly to an improvement in the quality of the product rather than the reverse.

Henry Ford in a recent book explains this phase of the problem of co-ordinating quality with quantity production in the following language:

"I have heard it said we have taken the skill out of work. We have not. We have put a higher skill into planning, management and tool building, and the results of this skill are enjoyed by the man who is not skilled, to his great benefit, for it is self-evident that a majority of the people in the world are not mentally, even if they are physically, capable of making a good living.

"We now have two general principles in all operations—that a man never shall have to take more than one step, if it can be avoided, and that no man need ever stoop over, in the foundry or elsewhere. Furthermore a man must not be hurried in his work—he must have every second necessary, but not a single unnecessary one. The results of these methods are visible everywhere in the Ford factories. Take the case of assembling the flywheel magneto. One workman doing this used to turn out 35 to 40 pieces in a 9-hour day, or about 15 minutes to an assembly. What he did alone was then spread into 29 operations. This cut down the assembly to 13 minutes. Then we raised the height of the bench at which the men work by 8 inches and cut down the time to 7 minutes. So today one man can do what two did."

CAREFUL AND UNIFORM CHARGING IS ESSENTIAL TO GOOD RESULTS—THIS VIEW IN A PROMINENT AMERICAN FOUNDRY SHOWS SPECIAL BUCKETS HOLDING 10,000 POUNDS IN WHICH PIG IRON CHARGES ARE ASSEMBLED

Hand Production Methods

We feel in the United States that it is not necessary to follow slow, expensive, hand-production methods to produce a quality product. Given raw materials of the proper sort coupled with methods which are right and an organization which insures the proper maintenance of standards, both as re-

gards raw materials and methods, the result must be a satisfactory product of uniformly high quality. We firmly believe this is true, but it is worth repeating that underlying this whole problem is the question not of energizing but controlling the processes of production.

This system of control begins in the foundry with the appointment of a man of the broadest possible foundry knowledge and experience to the position of foundry manager, making him responsible only to the works manager or general manager as the case may be. In other words he should be co-ordinate in salary and responsibility with the man in charge of the machine shop. Depending on the size of the shop, he should have a varying number of lieutenants in charge of the several foundry deparments such as the melting, molding, coremaking, cleaning, etc., including the patternmaking. A metallurgical chemist capable of doing not only routine but research work is essential; on him rests the chief burden of obtaining a metal of the proper quality. In a large shop a millwright's department is also necessary for keeping the machinery in order. The inspection and testing department is preferably independent of the foundry superintendent. If the plant is large enough the several department heads are assisted by subforemen and gang bosses as required. They all must be thorough foundrymen, and men of some culture and general education as well. They must be possessed of the temperament, tact and firm judgment which go with leadership. On all these men rests a heavy burden of responsibility, for the rank and file have only limited intelligence and training. Accordingly such men are well paid, and it is not uncommon for the general superintendent of the American foundry to draw a salary of $6500 a year with his chief lieutenants receiving from $2800 to $5000. Naturally there must be a large output over which to spread such a payroll and the strain on the leading men is correspondingly severe.

Controlling the Quality

Some further details regarding the production expected and attained under these conditions will now be presepted, accompanied by an explanation of the methods adopted and results obtained, thus bringing us to the heart of our discussion, which is to show with some definiteness the steps taken in large American foundries to control the quality of the product.

The control of quality in a foundry commences with the cupola or melting furnace, but since good metal is useless without good molds to pour it into, the latter will be considered first.

A most striking example of increased efficiency accompanying increased production was recently reported to the writer by M. A. Blakey, now foundry engineer for the International Harvester Co. In making automobile engines, the crankcase core is usually rammed up in two halves which are subsequently pasted together. These cores must be very accurate and it has been customary to rub down the joint of the core by hand to insure a satisfactory casting. The production under these conditions was approximately 10 half cores per man per hour. When he was at the Wilson Foundry & Machine Co., Mr. Blakey says, a machine was built to finish the joint between the two halves of this core by grinding. Two men with this equipment actually turned out regularly 125 half cores per man per hour, compared with 10 by the preceding method. The hand jointed cores varied from piece to piece by as much as 3/32 inch while the machine-made cores never varied more than 1/64 inch. By hand the quality of the product depended on the workman, whereas under the mechanical method it depended solely on the set-up of the machine, which had to be checked only at intervals of three or four days.

In another case mentioned by Mr. Blakey, on the testing bench where the cylinder blocks for Buick cars were subjected to water pressure before delivery to the machine shop, men working by hand each tested 14 sets of cylinders per hour. The holes were closed with clamping pads and expanding plugs. After becoming worn the plugs would occasionally blow out drenching the operator, who, when not under eyes of the foreman, became inclined to reduce the water pressure. This resulted in some leaky cylinder blocks finding their way into the machine shop, with generally deleterious effects on the quality of the output of the foundry. Later a semi-automatic test rig was provided which stopped all the holes securely and made it impossible for the operator to reduce the water pressure. This device was operated by one man who was thus enabled to handle 75 cylinder sets per hour. Three men were released for other work, but what was more important the substitution of an accurate machine for human frailty not only speeded up production but materially improved the general quality of the castings turned out.

The importance of constantly studying details of shop procedure in order to control and improve the quality of the product was clearly brought out some little time ago by Joseph J. Wilson, then plants manager of the General Motors Co., in an address before the National Founders association in New York. Speaking directly on the possibility of improving the quality of molds, and consequently castings, by the adoption of mechanical methods in place of so-called skilled hand labor, Mr. Wilson said:

"By studying the peculiarities of machine rammed molds and then designing our flasks accordingly we have been able to eliminate completely all gaggers from our production work. I will give an actual example. We received a job, patterns, flasks and machines, which had been running at an outside foundry for about two years, and is generally known as a bad job. The flasks were good cast-iron flasks with machined joints and the customary number of bars. It required 78 gaggers and 42 twenty-penny spikes for each mold. We designed a new flask which resulted in the elimination of all the gaggers and a reduction of the number of spikes and nails to eight for both the cope and drag. We also were able to discontinue tucking the bars. This made it possible for any laborer who can shovel sand to operate the machine and give us a perfect mold. What was considered a bad proposition has become a good job with a loss of under 10 per cent instead of the previous loss of 40 to 60 per cent. This is the only job on which we are using nails, although our work is all of a more or less intricate and irregular shape, and our sand has to be kept fairly weak in order to run our thin section work."

Getting The Right Sand

To operate successfully on the quantity production basis, special attention must be given to the handling of materials, especially pig iron and sand. Mr. Wilson points out that one crane operator and one laborer can unload 40 tons of pig iron with a magnet in an average time of 45 minutes. This estimate takes into consideration transferring the metal a distance of 50 feet. To do the same work by hand would require at least 15 men. "A modern installation for mixing facing sand," says Mr. Wilson, "may vary from a plain power riddle to a combination of a riddle, a crusher and a centrifugal machine. At the Central foundry the batch is made up in front of the riddle located on the floor level, the sand being shoveled into the riddle by hand. A short bucket elevator raises the sand from the riddle to the crushing mill in which the mixture is thoroughly ground. Another short elevator raises it to the top of the centrifugal mixer which discharges directly into bins below. The capacity of one of these units is 158 tons per 9 hours of continuous operation. A crew of three men making up the batches and running the machinery intermittently can mix about 46 tons of facing per day." Core sand may be handled along similar lines. This system means that the sand is mixed at minimum expense per ton, with the added advantage that given proper supervision it is absolutely uniform from day to day.

resulting in more satisfactory castings than where the molders are allowed to mix their own sand according to their own fancies or ideas.

Few foundrymen appreciate the weight of material handled in their shops per unit of output. Study of this question shows how necessary it is to give thought to the details of production. Along this line, Mr. Wilson said in the address already referred to that at the Buick foundry it was found that it was necessary to handle over 64 tons of material for every ton of finished castings produced, in spite of the fact that the plant is laid out so that a continuous flow of materials is possible.

"In order to save floor space and flask equipment at the Central foundry," said Mr. Wilson," the shop is run continuously, that is the pouring starts at 7 o'clock in the morning and the bottom is dropped at 4:30 p. m. After giving the matter considerable thought it was decided to set the molding machines in the middle of the floor instead of at one side as is customary. The operators start in the morning on one side of the machines and after placing about 24 molds, varying with the size of the job, they move to the other side. Then while they fill up this space, the molds on the side first filled are poured and shaken out and the sand is tempered and cut back to the machine with a traveling sand cutter. By this method 120 to 140 molds, each 24 x 36 inches, of a four-cylinder block with crankcase attached can be molded on a floor 24 x 60 feet in a day. This same floor space will also produce 100 to 110 six-cylinder blocks, each of these floors requiring an equipment of only 40 flasks. For jobs like crankcases requiring little core setting, which at the same time are quick cooling, a production of 200 to 225 molds requires a floor space of 960 square feet. Six hundred and thirty 12 x 18-inch snap molds have been produced on a floor space of 480 square feet."

At the plant of the Ferro Machine & Foundry Co., Cleveland, with methods akin to those just described, but using continuous conveyors, as high as 58 good Chevrolet cylinder castings an hour are being made.

Other Examples

These high production methods are not confined to the automobile industry, although it is in that field that they have reached their greatest development. For the new vehicular tunnels under the Hudson river 88,140 segment castings will be required with an aggregate weight of 115,000 tons. Although made wholesale these castings must conform to the most rigid specifications.

These castings are to be produced at the rate of 200 tons a day on large jolt-ram rollover molding machines using accurately fitted interchangeable flasks. The core prints are attached permanently to the pattern, and the end cores, which are of an odd size, are grouped on one large core; thus the chances for error are eliminated and the cores can be set with perfect accuracy by unskilled labor.

American railroad car wheels, which are of cast iron with a chilled tread, offer another example of a combination of rigid specifications and quantity production. Two hundred wheels a day may be regarded as the average output of a car-wheel foundry. This necessitates melting about 100 tons of iron a day and handling an immense tonnage of sand, flasks, etc. In most modern car wheel foundries the molds are arranged in long straight rows, each row being under a monorail hoist which serves to handle the flasks and molten iron. The molder is relieved of virtually all responsibility. He rams the sand, draws the pattern and sets the cores. He has to do no measuring; chaplets are supplied of the exact length required and are attached to permanent locations in the flask bars. Two men put up from 20 to 24 car wheels a day. The wheels weigh from 550 to 750 pounds each. Their average life is about 60,000 miles. They must conform to the most rigid tests and specifications, since breakage might easily result in a disastrous wreck. In fact only a fraction of a per cent of these wheels break in service, although the loads are frequently 10 tons per wheel.

Patterns Varnished with Clear Shellac

BY M. E. DUGGAN

A QUESTION frequently asked by apprentices is, "Why are not all patterns painted alike; some are black all over, some are black with yellow core prints while others again are painted yellow with black core prints and occasionally there is one that is not painted at all?"

There is no general standard for local conditions and requirements, and the personal preference of the management of the particular shop making the pattern regulates, to a large extent, the methods to be followed in finishing it. Black shellac on the pattern and light shellac on the core prints is the almost universal rule for gray-iron shops. Brass-casting shops reverse the rule and paint their patterns yellow and the core prints black. The pattern intended for the steel foundry is generally painted black with red core prints. In some places the method of finishing the pattern is left to the discretion of the man who makes it; in others, a certain standard practice is maintained.

I have worked in shops where every pattern, regardless of the number of castings wanted from it, had to be finished in *A*1 style, the corners rounded and the angles filled with wood; the nails and brads had to be all countersunk and the holes filled with beeswax. Each pattern received a final rub down with No. 00 sand paper and was then given three coats of black shellac. The firm wanted its patterns made that way and their men worked accordingly.

In other shops putty was used instead of bees-wax, not because the latter could not be had but because in the foreman's opinion putty was good enough. In still another class of shops, if a man was discovered countersinking nails or varnishing a pattern when only a limited number of castings was required, it was considered a sufficient cause for his discharge.

A workman recently inquired why I give all my patterns a light colored finish and was told that it is because considerable altering and repairing is done and the patterns are subjected to pretty rough usage. They are fastened with nails as well as glue during construction. When a pattern is finished with a light-colored shellac I can see where the nails and screws are located and am not so apt to spoil a hand or power tool, especially the band saw, as is frequently done when altering a pattern which is painted black. It is not uncommon to be able to trace the high cost of some patterns to the time spent on unnecessary finishing.

British Hold Meeting

Lord Weir presided at the first annual meeting of the British Cast Iron Research association held in London Nov. 23. He said the needs of the industry presented a serious problem and the association might reasonably claim the strongest support from the foundries. Sir Frank Heath, secretary of the department of scientific and industrial Research said the Foundry industry was confronted by the competition of America, because of the better technique which existed in its foundries.

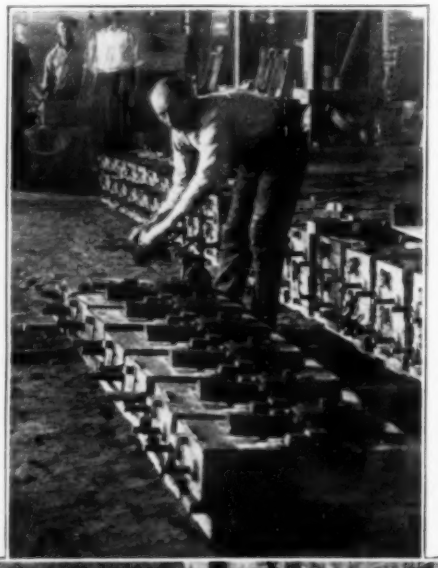
Navy Yard Makes Gas Engines

To Meet the Increased Demand for this Type of Engine Designed for Use in All the Smaller Naval Boats Equipment Was Provided for Pouring 60 Cylinders a Day

BY S. W. BRINSON

SEVERAL years ago the United States navy department decided to equip its small boats with independent power units and dispense with the steam launches employed to tow other small boats. A number of commercial engines were tested and from the results of these tests the bureau of engineering designed the navy type engine which embodies the advantages of several of the tested engines and also, by its simplicity and ruggedness has met the severe demands of the naval service. The engine is a 2-cycle, 3-port type, assembled in four sizes comprising one, two, three, or four identical cylinders.

Successfully casting the cylinders for these engines presents a constant problem in a shop designed for and devoted mostly to large miscellaneous repair work. The cylinder is designed for a 4½-inch bore, is water jacketed around its entire working surface and has the three ports cored in place. One for the gas intake, another, just above this for the exhaust and the third on the opposite side, a double port, for transferring the gas from the crankcase to the cylinder. Formerly a spark plug hole also was cored in, but this feature has been moved to the cylinder head.



A single rollover molding machine was used at first for making both copes and drags as the production at that time was small. During the war the demand for the engines became so great and the navy yard foundry was so completely swamped with urgent repair work that it became necessary to purchase 5000 cylinders from an outside interest. Afterward owing to a number of reasons the need of cylinders became so great that it was realized the rollover machine could not produce the complete molds fast enough and that other steps would have to be taken to increase production.

Two plain jolt machines were moved from their locations and placed close together at one end of the cylinder floor with a small stand to hold nails, tools, etc., between them as shown in

FIG. 1—SETTING THE CORES FIG. 2—GENERAL ARRANGEMENT OF FLOOR ON WHICH THE GAS ENGINE CYLINDERS ARE MADE—TWO JOLT, STRIPPING PLATE MACHINES ARE EMPLOYED, ONE FOR THE COPE AND THE OTHER FOR THE DRAG

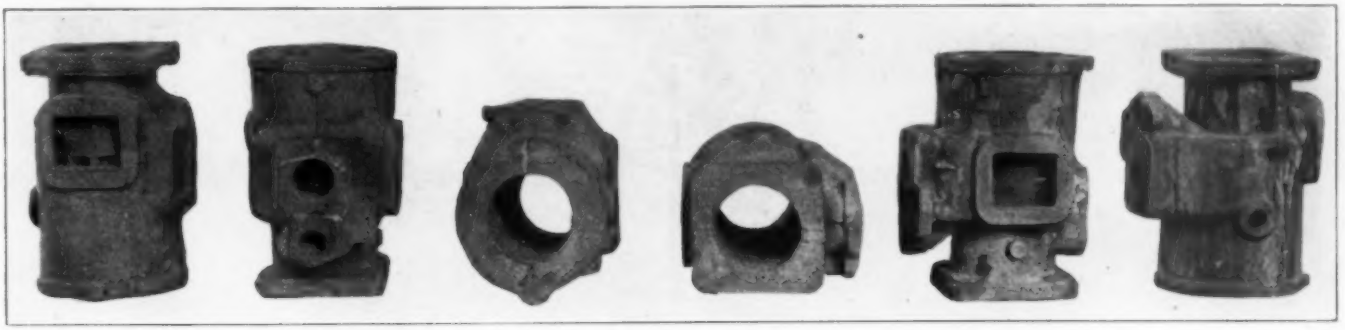


FIG. 3—SIX DIFFERENT VIEWS OF THE CASTING SHOWING CORE DISTRIBUTION

the foreground Fig. 2. The drag pattern was placed on one machine and the cope pattern placed on the other. A molder and a helper were assigned to each machine and another molder and helper attended to setting the cores.

After the drag is rammed the pattern is stripped down through the plate and then the drag is lifted and rolled over on a table at a slightly lower level than the table of the machine. From the table the drag is taken by an electric monorail hoist to its position on the floor. A drag lifted off the pattern plate and partly rolled over is shown in Fig. 5. After the drag has been set on the floor the cores are set by the molder assigned to this part of the work. On account of the design of the cylinder all the cores cannot be assembled and lowered into the mold as a unit. They are pasted in groups only and located in the mold by suitable gages. Fig. 1 shows a molder setting the cores and Fig. 4 is a closeup view of the cores set in a dummy dry sand mold used for checking the cores occasionally. This illustration also shows the type of strainer gates employed.

The method of blacking and drying the barrel cores is shown in Fig. 6. The blacking is sprayed from a can connected to the compressed air line and the blacking is dried by a blow torch connected in a similar manner. The torch shown in the illustration was invented by one of the molders in the shop. The piston core and also the 4-cylinder exhaust manifold cores for this type engine are shown resting on top of the barrel cores.

After the cope is rammed and

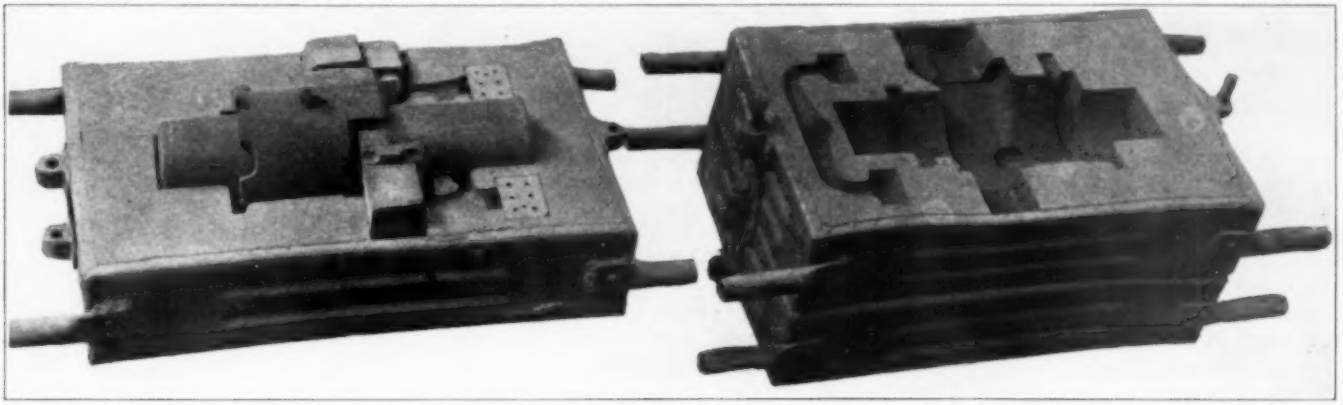


FIG. 4—CLOSE-UP VIEW OF COPE AND DRAG WITH CORES IN POSITION—THE CASTING IS POURED THROUGH TWO STRAINER GATES FED FROM A SINGLE CENTRAL RUNNER

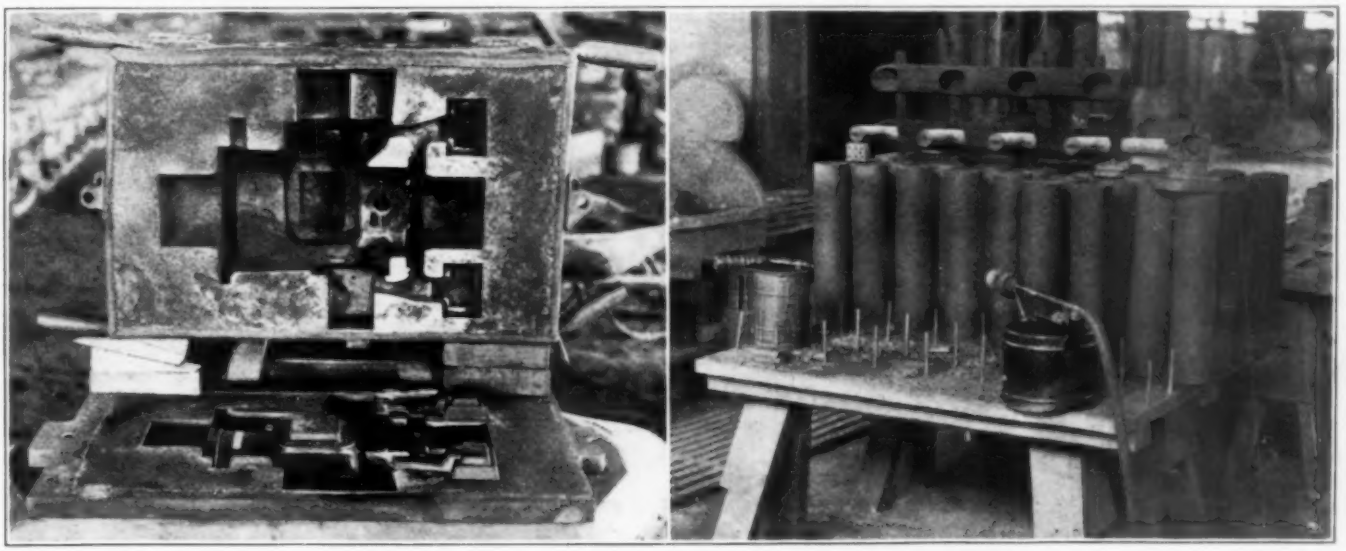


FIG. 5—DRAG AS IT APPEARS WHEN LIFTED OFF THE STRIPPING PLATE—FIG. 6—THE BARREL CORES ARE BLACKED WITH A SPRAY CAN AND DRIED WITH A BLOW TORCH

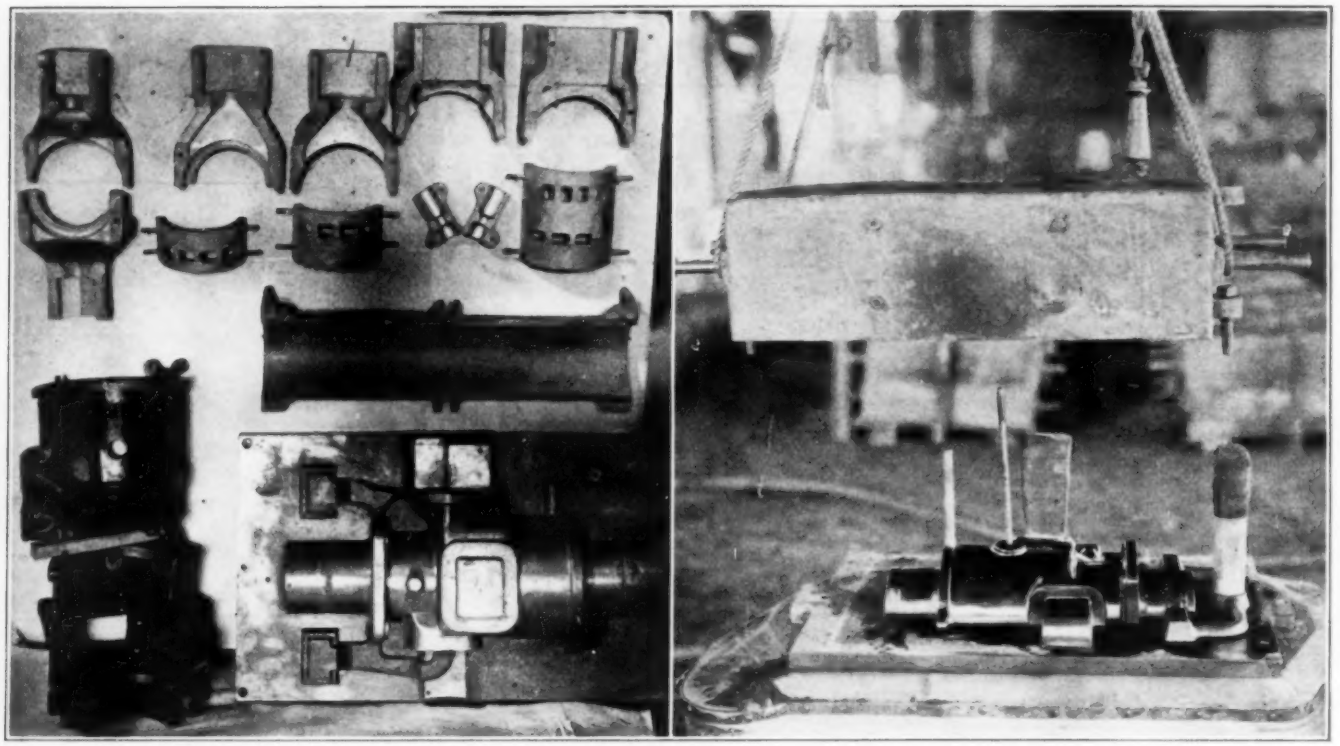


FIG. 7—PATTERN PLATE CONTAINING DRAG PATTERN ALSO THE VARIOUS METAL COREBOXES—FIG. 8—COPE HALF OF THE PATTERN AS IT APPEARS AFTER THE COPE IS LIFTED OFF—NOTE THE ROPE SLING

stripped from the pattern, it is lifted vertically as shown in Fig. 8 by another electric monorail hoist, and placed in position on the drag after the cores have been set. It has been found that any little patching could be done after the cope was lifted without rolling it over. After the cope is placed the mold is clamped and then is ready for pouring.

All the cores are made in either iron or brass coreboxes on a bench and placed on a rack as they are made. The full rack is taken away by conveyor and an empty rack placed in its stead. The full rack is placed in a conveyor rack oven and after the cores are dried they are placed on the storage shelves. All cores are made on the gallery floor of the foundry. The cylinder pattern and the coreboxes are shown in Fig. 7.

The foundry, employed principally on repair work, is run on a daily wage basis and no piece work or premium system is used. Shortly after the cylinder was placed on a production basis an output of 60 castings a day was secured from the six men enumerated. Fig. 2 shows a day's production ready for pouring and also shows the arrangement of the machines in relation to the molding floor. Approximate analysis of the iron poured into the cylinder molds follows: Combined carbon 0.60 per cent; free carbon 2.60 per cent; silicon 2.00 per cent; manganese 0.60 per cent; phosphorus 0.25 per cent; sulphur 0.10 per cent. As the cylinder castings require only part of the entire amount of iron melted and as the remainder of the iron generally is of a lower grade, 1000 pounds leeway is allowed before and after the cylinder iron, in charging the cupola.

After the castings are poured, knocked out and cleaned, the inside of the water jacket is pickled with a solution of sal-ammoniac and the castings then are subjected to a water pressure test of not over 40 pounds. Six different views of the cylinder casting are shown in Fig. 4. Reading from left to right they are: the transfer port, the exhaust and intake ports, the top of the cylinder, the bottom, the water jacket opening and the side opposite which shows a cored hole for locating the water jacket core and for cleaning.

Indiana Foundrymen in First Conference

In response to requests made by foundrymen from various parts of the state the engineering extension division of Purdue University, Lafayette, Ind., arranged a conference to be held Nov. 23 and 24 in the Michael Golden shops of the university. The purpose of the conference was to effect an organization among the foundrymen of the state along the same lines as those adopted in other parts of the country. A. J. Tuscany, secretary manager of the Ohio state foundrymen's association, delivered an address on team work in the industry which outlined the aims and objects and also the progress made to date by the association he represents. The address was followed by discussion led by A. J. Rumely, La Porte Foundry & Furnace Co., La Porte, Ind., dealing principally with cost systems and details of organization. The incoming board of officers was instructed to prepare a constitution and by-laws based on those in use by the Ohio association. The following papers were presented during the 2-day session:

Foundry Conditions in Indiana, R. E. Wendt, instructor in foundry practice, Purdue University, Lafayette.

Layout and Design of a Modern Foundry, F. D. Chase, F. D. Chase, Inc., engineers, Chicago.

Manufacture of Pig Iron, H. B. Northrup, Diamond Chain & Mfg. Co., Indianapolis.

Manufacture of Malleable Iron, N. M. Waterbury, Link-Belt Co., Indianapolis.

Warpage in Iron, J. F. Keller, heat specialist, engineering extension, Lafayette.

Cost Keeping, E. T. Runge, E. T. Runge Cost Co., Cleveland.

Metallurgy in the Foundry, J. H. Hopp, C. C. Kawin Co., Chicago.

Why Research Pays, H. C. Peffer, head, school of chemical engineering, Lafayette.

Charting the Cupola Charge, Prof. L. J. Campbell, University of Michigan, Ann Arbor, Mich.

W. D. Hammerstadt, Rockwood Mfg. Co., Indianapolis, was elected president, W. N. Durbin, Anderson Foundry & Machine Co., Anderson, Ind., vice president, W. J. Price, Lavelle Foundry Co., Anderson, Ind., secretary-treasurer.

Studies Changes in Grain Size

Extended Tests Show Fineness of Silica Sand Not Increased by Additions of Fireclay, but the Clay Builds Up on the Grains of Sand Enlarging Them—Results of Sieve Test Given

BY R. L. DOTY

TO THOSE foundrymen specializing in small steel castings, facing sand is of vital importance. This is particularly true where small steel castings are produced in green sand. Every man responsible for the production of such castings sooner or later has certain ideas as to what will make facing better or worse.

A common theory, and one usually accepted as fact, is that the constant addition of clay to sand where heap sand is used as a part of the batch, causes the facing to become closer or finer. The writer believed this, too, until confronted by facts which indicated that this theory is not true in all cases.

One morning, while examining some castings, he was seized with the idea that a certain combination would produce cleaner castings. Several batches of sand were prepared, and the castings made in this sand were examined carefully. The results were so gratifying that after repeating the test several times the mixture was adopted as standard for the shop.

It must be admitted that this course was decided upon with some misgiving, for the theory already mentioned was considered true; but he believed that nothing serious could happen without some warning. In addition, the shop was protected by the practice of testing the facing sand for permeability, grain size, green bonded strength, and moisture each morning and afternoon.

At the end of a week our sand was a little more permeable. At the end of a month this was more noticeable. At the end of six months, and again at the end of the year, it was still more open.

For a year we had been using heap sand over and over in our facing, adding clay to it each time it went through the mill. At the start we had been afraid it would soon become too close, yet at the end of a year it was more open. To become more open, it would have to become coarser first; and to become coarser, it would act contrary to the old belief that the constant addition of clay would make it finer.

At this point it seemed a study of the effect upon the grain size of silica sand through the constant addition of fireclay would be worth while. The writer decided to carry on this investigation, using every precaution to guard against error and to eliminate so far as possible all uncertainties.

A quantity of washed and dried silica sand was put into a bin and kept for this work. This sand was transferred from the unloading point to this bin by wheelbarrows, and a sample taken from each barrow. These samples were combined and put through the sample splitter shown at the right in Fig. 1.

Using the nest of standard sieves and the ro-tap shown in Fig. 1, its average grain size was found to be 0.01283-inch. In the same manner, fireclay was stored, sampled and tested. Its grain size was found to be 0.01144-inch.

To guard against the introduction of anything into the sample other than the sand and clay just mentioned, the following practice was adopted and followed during the entire test.

Precautions Taken

Molds were made on floor or bench, but no sand other than the experimental facing was used in any mold, i. e., molds were rammed of facing only, no heap sand being used. Where possible, patterns requiring no cores were used; and where cores had to be used, they were small and of such nature as to remain in the casting.

The writer or a molding foreman supervised the pouring of every mold to make sure that nothing was thrown on the mold to cover hot metal in heads and gates. A large steel plate was placed in a convenient part of the shop. This plate was carefully cleaned each time so that no foreign matter entered the sand from it. The castings were pulled out to one side of the plate with the usual amount of sand adhering to them. The sand from this plate was shoveled into wheelbarrows, previously cleaned, and covered with a clean sack. This sand was locked up until the next day for use in the next batch.

When the castings were cold, a sample from the sand adhering to them was taken. Fig. 2 illustrates a typical case: *A* is the fused portion which adjoins the casting; *B* is that portion of the sand near the casting, the bond of which is destroyed by the casting temperature; *C* is that layer of sand near enough to be baked, but not near enough to be burned.

Our reason for this step will be evident. Facing from the mill might, upon test, show a grain size apparently greater than the original sand. The same facing after exposure to casting temperature might have its grains broken down by that temperature, in which case it would be finer than when it came from the mill, and perhaps finer than the original sand. In actual practice much of this sand would get into our heaps and would affect them. Therefore we tested for grain size taking a sample from the mill and a sample of the same sand from *B* after casting and cooling.

Each batch was mixed in the same mill, one of the heavy muller type, and all the batches were milled for the same length of time. Before introducing the material into the mill all parts were cleaned. The plows, sides and faces of mullers were cleaned with a scraper followed by a broom while the machine was in operation. By a thorough use of shovel and broom, all loose material then was removed from the pan. The plows were adjusted carefully by the writer, and their setting measured so that as wear developed, they could be readjusted, thus maintaining as closely as possible the same mechanical turning over of the batch through the entire experiment.

The idea was to start with all new sand and clay, for this, after a time, would become heap sand, the contents of which were known to us. After producing this heap sand, we could use it in conjunction with new sand and clay exactly as we were doing in everyday practice during which we had noticed an increase in the openness.

This practice, if followed, would of necessity show what effect the constant addition of clay to sand would have on the openness of our facing, for since no material other than clay was added, the results found, whatever they might be, could be due to clay only.

The writer believes he is justified in making this statement, for the only other factor which might enter would be the effect of casting temperature upon the sand and clay, and this uncertainty had been guarded against by sampling the burned sand.

The first batch required a heavy clay addition to provide sufficient bond. The

Paper presented at the Rochester meeting of the American Foundrymen's association.

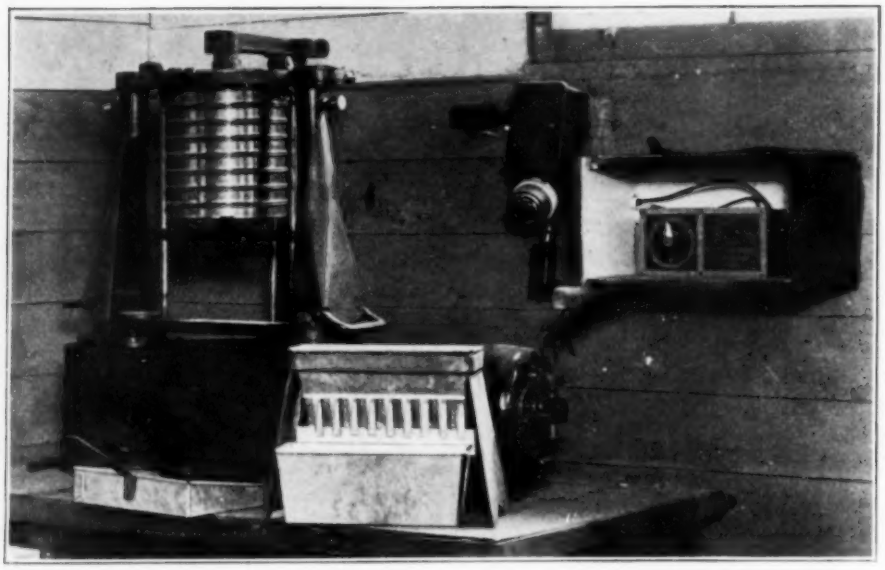


FIG. 1—APPARATUS USED FOR TESTING SILICA SAND

next four batches contained less clay and varied somewhat in the clay content, as they did in the addition of new sand.

Of course, the reason for this is that some sand was lost in filling the molds, in shaking out and through adherence to the castings. The standard batch was ten 12-quart pails, so in the first seven batches we used what sand was saved, adding sufficient new sand to bring the batch up to standard size. After batch seven we saw that it would be possible to recover seven pails from each batch, so we adopted the standard mixture of—

7 pails (84 quarts) used sand.
3 pails (36 quarts) new sand.
5 quarts fireclay.

and varied from that in but the single case of batch 14, where we lost four pails instead of three.

The writer feels that the results obtained can best and most briefly be described if done graphically. So attention is directed to the chart in Fig. 3. The figures at the left indicate the grain size expressed in inches, while those at the bottom represent the batches. The lower horizontal line shows the average grain size of the clay used, while the upper represents that of the silica sand. The lower irregular line represents the grain size of the sand taken from *B*, Fig. 2. This indicates that this sand, though brought to a high temperature, where it might be expected to be broken up, is coarser than the original silica sand.

Tendency Not To Become Finer

The upper irregular line represents the grain size of our facing, and is that with which we are most concerned. It indicates clearly that in spite of occasional recessions the tendency is not to become finer, but, in fact, to become distinctly coarser after batch No. 14. A question might naturally arise regarding the tendency to become finer from batch No. 9 to batch No. 14 It is to be regretted that I did not make sieve tests of that particular silica sand which was added to each batch under investigation. If that had been done, there might be offered a satisfactory explanation of the temporary recession mentioned. If the tendency of the facing to reduce in grain size throughout the preparation of a few batches was not due to a corresponding reduction in the grain size of the pure sand, I can offer no explanation of the drop in the curve. The significant thing is that the curve shows no general tendency to fall, despite the continued additions of clay. In this connection it may be observed that the curve showing the grain size of the sand as milled never approaches the line showing the average grain size of the silica sand. The silica sand is appreciably smaller than that of the batch of facing which exhibited the finest grain size.

Increase Is Pronounced

The influence of clay to increase grain size above that of the natural sand is so pronounced as to indicate that the constant addition of clay to sand will in the presence of water and under the action of mullers make the mixture coarser instead of finer up to that point where the strength of the envelop is not sufficient to resist the abrasive action in milling, which would tend to make fragments of the envelop spawl off. I hope later to ascertain at what stage of the continual introduction of clay such a tendency is observed. Supporting this statement are the figures obtained in determining the grain size of the various batches and shown in the accompanying table. The left hand column is a list by number of the sieves used in each test. The second column is the opening of the sieves expressed in inches. The third column gives the percentage retained by each sieve in the test of the washed and dried silica sand. The fourth column is the average of the percentages retained on each screen during the test of the facing sand. These averages were obtained by adding together the percentage retained on each test and dividing by the total number of tests. Column five indicates the percentage of increase in the amount retained on the individual screens; and column six the percentage of decrease.

These tests show that increase in grain

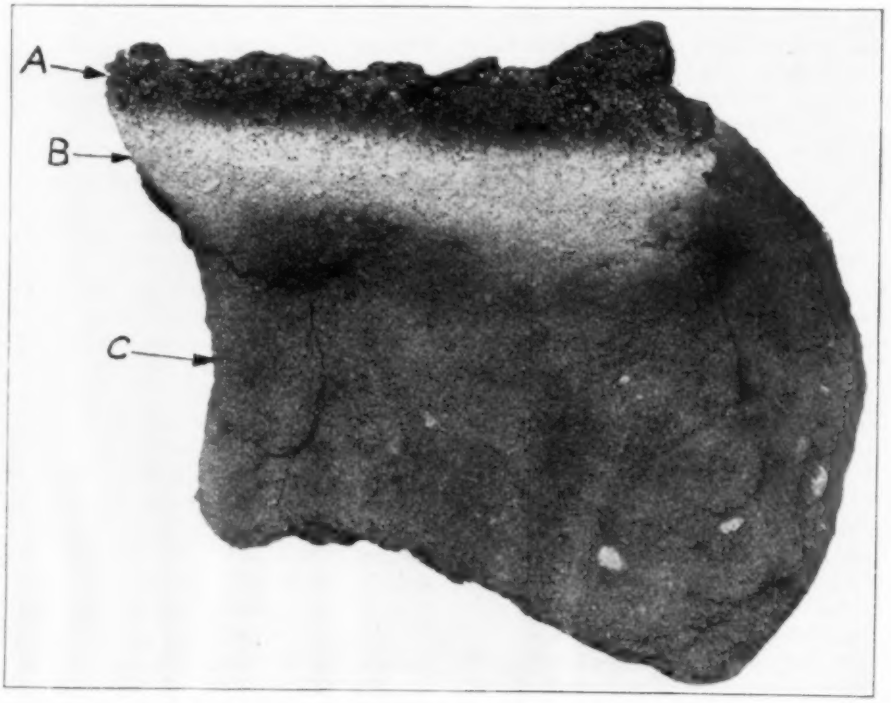


FIG. 2—SAND TAKEN FROM THE SURFACE OF A CASTING—NOTE THE THREE DIFFERENT AREAS, STARTING WITH THE UPPER EDGE WHICH WAS AGAINST THE CASTING

size did occur and where it was most pronounced. In the case of the original sand, 75.24 per cent was retained on the No. 20, 30, 40 and 50 sieves; while in the case of the sand to which clay had been added constantly, 82.79 per cent remained on the same sieves. Notice, too, that while the percentage retained on the coarser sieves increased, there was a decrease in the percentage on the finer.

To test the theory further, a sample was taken and its grain size determined. This sample was placed in a 240-mesh sieve and washed thoroughly. After washing it was dried and again tested for grain size. The change was marked as shown by the comparative figures in the following table:

Sieve No.	Sample as taken	Sample after washing
20	0.30	0.60
30	12.60	8.95
40	34.20	27.80
50	35.30	38.00
70	10.85	13.85
100	3.71	6.22
140	1.50	2.91
200	0.63	1.46
200+	0.81	0.22
	99.90	100.01
Average grain size..	0.01403 inch	0.01309 inch

If the addition of clay tended to make sand finer, then the removal of that clay should reverse the process and make the sand coarser. In washing this sand we had taken clay from it, and our resulting sand had become finer instead of coarser.

Attention is called to the accompanying micrographs. Here it seems we have visible proof of the figures already quoted.

Fig. 4 shows a comparison between the original silica sand, and the same sand after having been through the mill 22 times, clay having been added each time, molds made from it and poured between each milling operation. The clear, smooth grains at the left are of the original sand; the irregular, warty grains at the right are after the repeated milling and use. In Fig. 5 the grains at the left are some of those warty grains. At the right are other grains from the same sample after they had been rolled between two glass plates.

To the writer it seems that no great

(*Concluded on Page 996*)

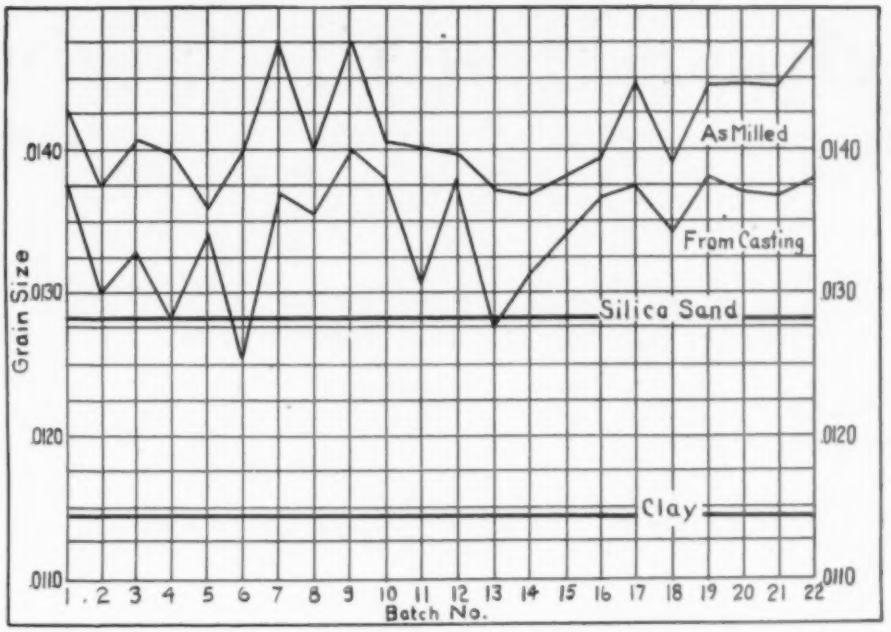


FIG. 3—CHART SHOWING HOW ADDITIONS OF CLAY AFFECT GRAIN SIZE

Figures Obtained in Determining Grain Size

Sieve No.	Size of Opening	—Per Cent Retained— Silica	Facing	Per Cent Increase	Per Cent Decrease
20	0.0331	0.15	0.84	460.0	...
30	0.0232	8.47	11.25	32.8	...
40	0.0165	26.82	34.90	30.1	...
50	0.0117	39.80	35.80	...	10.0
70	0.0083	14.39	10.10	...	29.9
100	0.0059	5.94	3.69	...	37.8
140	0.0041	2.79	1.91	...	31.5
200	0.0029	1.05	0.52	...	50.0
200+	0.0024	0.41	0.75	83.0	...
Total....	.....	99.82	99.76	...	...

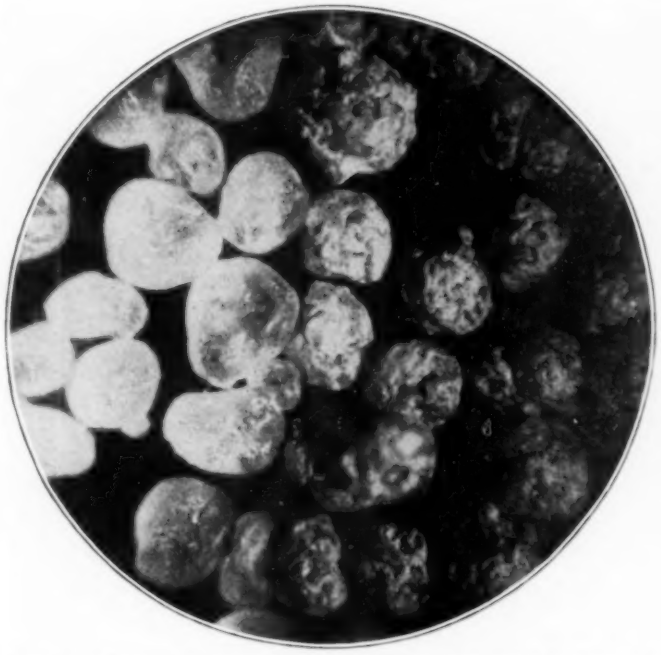


FIG. 4—ORIGINAL SAND AT THE LEFT AND THE IRREGULAR GRAINS AT THE RIGHT HAVE HAD REPEATED MILLING AND USE FIG. 5—GRAINS OF USED SAND AT THE LEFT—GRAINS FROM THE SAME SAMPLE, AFTER BEING ROLLED BETWEEN TWO GLASS PLATES ARE SHOWN AT THE RIGHT

Open-Hearth Steel Practice

Water-Cooled Devices Tend To Stabilize Furnace Operations—Blow-Torch Principle in Parts Give More Intimate Mixture of Gas and Air and Reduces Melting Time

BY WILLIS McKEE

UNTIL the last couple of years, probably no process in the steelmaking industry progressed less since its introduction than the making of steel in the open-hearth furnace. From the building of the first successful furnace in this country a little more than 50 years ago there had been no basic change in open-hearth construction. It is true that during this time the units had become larger and more substantially built; the facilities for handling the materials to and from the furnaces had become much more satisfactory; improved valves had been invented; water cooled ports, doors, door frames and buckstays had been employed and slag line coolers had been installed; but the time of the making of the heat had remained approximately the same, the fuel economies had been improved but little and the operation of the furnace was no more under the control of the operator than a half century ago. The problem of satisfactory refractories is still unsolved, although this phase of the problem is now receiving most intensive study and consideration. The operation of the units is intermittent, shut-downs being necessitated every few weeks for repairs to the brick work.

About 10 years ago, a careful test was run at the Homestead works of the Carnegie Steel Co. to determine the heat balance of the open-hearth furnaces. The furnace used in the test made an average heat of 54.6 tons; natural gas was used as fuel. This test was run for seven or eight months. The results proved that the losses due to the temperature of the ecaping gases, radiation, conduction and other causes amounted to 95.77 per cent of the heat units supplied by the combustion of the incoming fuel. This brings us to the startling conclusion that if we could eliminate all such losses that there would be only about 20 to 30 pounds of coal required per ton of steel produced. It is not to be expected that any such efficiency can be obtained, but it is time that careful thought be given to the saving of our fuel supplies and to the lowering of the cost of steelmaking by their more economical use.

While blast furnace linings last from three to eight years, open-hearth units are not expected to remain in operation over four to five months. It is always expected that at least one furnace will be down in each shop for rebuilding and the other units will be frequently shut down for short periods for minor repairs.

Decreases Thermal Efficiency

In the last 10 years, the use of water-cooled devices has had a tendency to stabilize the operation of the furnaces, but excessive use of water of course decreases the thermal efficiency of the furnace, so that the use of such equipment must not be carried to excess. The use of waste heat boilers has materially decreased the heat losses but at a considerable cost of installation. The fact that the stack losses are great enough to justify the installation of waste heat boilers helps us to realize the inefficiency of the process.

The greatest cause of the low efficiency is imperfect or delayed combustion. It has been customary to introduce the gas into the hearth in a semicircular port at about ½ to 1-inch pressure and to introduce the air around it at a pressure which is created by the column of heated air from the bottom of the checkers to the top of the uptake. Although it was early appreciated that it was necessary, in order to obtain the temperature required in the open-hearth furnace, to preheat both the gas and air to as high a temperature as possible, no attempt appears to have been made to see that the gas and air were intimately mixed with the result that although some particles of air and gas mixed promptly at the end of the port and combustion started quickly, other particles of air never came in contact with the gas until reaching the other end of the hearth and frequently not until they had reached the slag pockets or regenerator chambers in the outgoing end of the furnace. This delayed combustion not only decreases the thermal efficiency of the furnace and lengthens the time required for a heat, but it causes needless destruction of the uptakes, slag

Paper presented at the Rochester convention of the American Foundrymen's association.

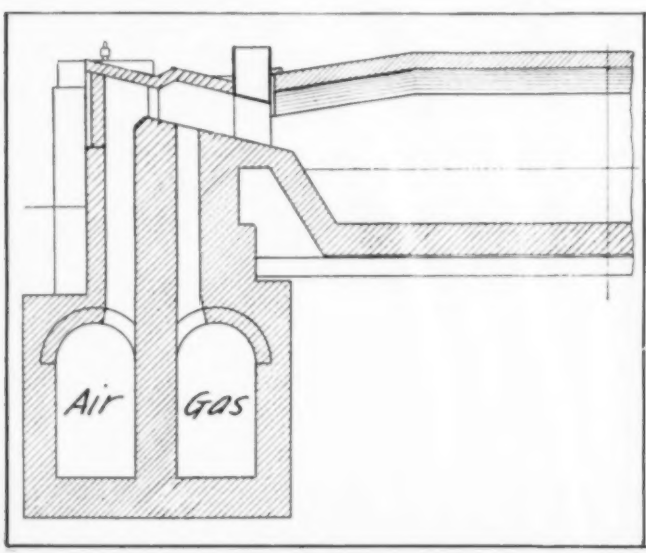


FIG. 1—SECTION THROUGH COMBINED PORT OF BLOW TORCH FURNACE

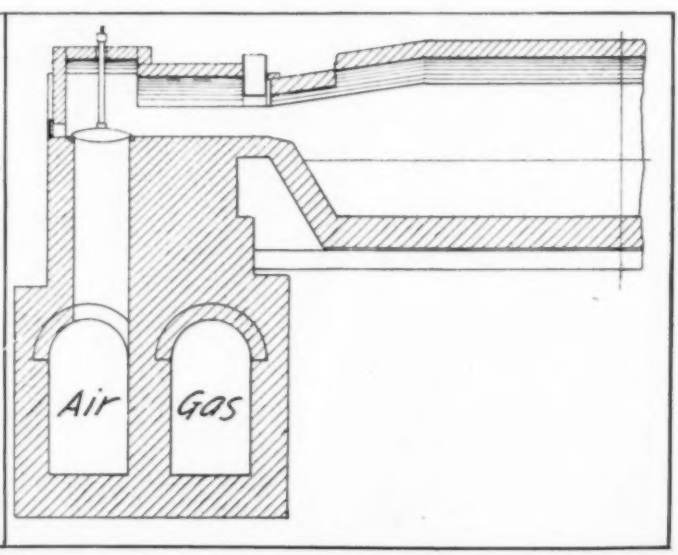


FIG. 2—SECTION THROUGH AUXILIARY OUTLET VALVE

THE FOUNDRY DATA SHEET, DECEMBER 15, 1922
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

MICROSCOPY OF CAST IRON

(*Continued from Data Sheet No.* 456)

For some purposes concentrated nitric acid and 50 per cent aqueous solutions of nitric acid are used. Nitric acid, used as a 5 per cent solution in alcohol, acts on the different constituents of iron and steel in much the same manner as picric acid. It produces rather coarse etching and is not much used in work at high magnifications. It develops the ferritic structure in iron and steel more rapidly than picric acid does, making the grain boundaries appear distinctly. Nitric acid has proved useful to the author in etching tin-lead bronzes and aluminum bronze.

Sodium picrate may be made using 2 grams picric acid, 25 grams sodium hydrate, and 75 c.c. water. The sample is immersed a few minutes in the boiling reagent. Cementite is colored deeply, ternary steadite (P-Fe-Fe_3C) appears black, and binary steadite (P-Fe) is somewhat discolored. Ferrite and austenite appear white, and pearlite is not visibly changed. By comparing this action with the action of picric acid it may be seen that these two reagents afford a ready means of distinguishing cementite from ferrite. Sodium picrate is most useful in identifying irons and steels of slightly hypereutectic matrix, and for etching white irons.

In research the worker meets problems different from those met in routine practice. Etching practice must be varied to meet the individual case. Such work naturally leads to development of new methods and reagents. Tables such as those published in Data Sheets, Nos. 335 to 338, June 1 and 15, 1920 will prove very useful.

To amplify these tables a few particular methods, either worked out or adopted by the laboratory of the Niles Tool Works Co. are given. These afford a good idea of the procedure and indicate methods found especially valuable in gray iron work.

(*Continued on Data Sheet No.* 458)

MICROSCOPY OF CAST IRON

(*Continued from Data Sheet No.* 457)

PROGRESSIVE CHANGES DURING HEAT TINTING

Color of Specimen to the Eye

FIRST PERCEPTIBLE YELLOW	GENERAL MEDIUM BROWN, NO PURPLE
Steadite	**Steadite**
X 100 dia.-white X 500 dia.-matrix white, dots dark	X 100 dia.-light grayish X 500 dia.-matrix grayish, dots purple
Graphite	**Graphite**
X 100 dia.-lusterless black, purple edged X 500 dia.-shows many blue dots in and along edges	X 500 dia.-shows red, purple and white along edge
Ferrite	**Ferrite**
X 500 dia.-brown, blue dots	Brown at 500 dia., changing to purple with blue dots
Pearlite	**Pearlite**
X 500 dia.-cementite white, ferrite brown	X 100 dia.-brown
Major Color	**Major Color**
X 100 dia.-brownish yellow	X 100 dia.-light brown

Color of Specimen to the Eye

DARK BROWN WITH TOUCHES OF PURPLE	RED PURPLE WITH BLUE SPOTS	BLUE AND WHITE
Steadite	**Steadite**	**Steadite**
X 100 dia.-dark spots show in eutectic X 500 dia.-dots have changed to blue, purple along edges of dendrites	X 100 dia.-purple along edge X 500 dia.-matrix yellowish red	X 500 dia.-matrix red, white dots
Graphite	**Graphite**	**Graphite**
More blue and less purple along edges	Same	White and blue along edges—Shows network at high magnification
Ferrite	**Ferrite**	**Ferrite**
As graphite	Blue and white	White and blue
Pearlite	**Pearlite**	**Pearlite**
Purple and brown, laminae do not show	Purple and red	Purple and blue
Major Color	**Major Color**	**Major Color**
Brown with purple shades	Red and blue	Blue and white

(*Continued on Data Sheet No.* 459)

pockets and regenerators. In order to insure combustion it has been customary to supply additional air, which, of course, decreases the thermal efficiency. In the test previously mentioned, it was found that 150 per cent excess air was actually being used. If such excess is maintained while conducting a test, it is to be assumed that under normal conditions even worse practice prevails.

Try For Better Mixture

Only about three years ago it was first proposed to mix the fuel and air before they entered the hearth of the furnace so as to obtain complete combustion promptly. This is an application of the Bunsen burner or blow torch principle which was invented some 65 years ago with the exception that the Bunsen burner insures against burning in the mixing chamber by having the velocity of the gases such that the flames cannot travel back into the mixing chamber. In an open-hearth furnace the temperature of the gases coming from the regenerators is so high that the flame is initiated as soon as the gases come in contact with each other. It is, therefore, necessary in order to use this principle to cause the gases to travel at such a velocity that there will not be enough combustion in the port to raise the temperature to such a point as to cause rapid destruction of the port.

Figs. 1, 2, 3 and 4 show the construction of the blow torch port similar to what has been used successfully at the plant of the Brier Hill Steel Co. The air and gas are introduced into the regenerators in the usual way except the air is under 2 or 3-inch pressure and then the air and gas are admitted into the same port from which they issue properly mixed, at a high velocity.

After a careful study of the requirements of a successful blow torch or Bunsen burner installation, it has been found that the following conditions must be met:

When using producer gas it is necessary to so introduce the air and gas that excessive gas house pressure will not be required. In other words, if over 1½-inch air pressure is used (and a higher pressure has been found desirable) it is necessary to aspirate the gas so that the proper amount of gas can be introduced without necessitating a gas house pressure in excess of 2 inches.

It is necessary to insure a perfect mixture of the gas and air before they issue from the port.

It is necessary to properly direct the flame so that it will impinge sharply upon the bath so as not only to obtain full benefit of the blow torch flame but to prevent it coming in contact with the brick work.

Adequate outlet ports must be provided to carry off the products of combustion.

These conditions are fully met in the construction shown. The combined port is long enough not only to thoroughly mix the gas and air but to properly direct the flame upon the bath. The velocity of the gases is such as to avoid excessive combustion in the port. The ports are exterior of the furnace, that is, the brick work forming the port is not subject to the high temperature of the furnace on both sides. This greatly lengthens the life of the ports. The valve arrangement is simple and not liable to get out of order due to expansion and contraction of the brickwork.

In the operation of a furnace of this description at the plant of the Brier Hill Steel Co. at Youngstown, using natural gas, 9111 tons of high grade basic open-hearth steel were made in 31 days, with a charge consisting of 65 per cent heavy melting scrap, 6 per cent cold pig iron and 29 per cent hot metal. The best tonnage ever made in this shop on a furnace using ordinary method of construction was 6344 tons, and this record was made when using a mix of 45 per cent scrap and 55 per cent hot metal. The average monthly output per furnace of this shop operating on approximately 45 per cent scrap is 5000 tons per month.

On account of the short, sharp, blow torch flame the gases attain their highest temperature and combustion is completed before they reach the middle of the hearth. From this point their temperature drops rapidly due to the radiation and transmission of heat to the bath, so that, notwithstanding the fact that the flame in this furnace is much hotter than in other furnaces, the temperature of the escaping gases in the downtakes and in the regenerator chambers is very considerably decreased. In other words, the combustion is completed so early that the maximum amount of heat is retained in the bath, greatly increasing the thermal efficiency of the unit and decreasing the repairs to the downtakes and regenerator chambers.

In practice at the Brier Hill Steel Co.'s plant, the stack temperatures have been found to average 300 degrees Fahr. lower than in their other furnaces. There is not enough data collected as yet to show just what fuel economies can be obtained, but it appears that the saving will be in the neighborhood of 20 to 25 per cent.

One of the greatest advantages of the system is due to the fact that the fuel and air are thoroughly under the control of the operator so that the temperature of the bath can be regulated to a nicety. On account of the thermal efficiency of the furnace there is less contamination of the bath from the impurities in the fuel.

Although attention is called to the fact that greater economies and greater production can be procured due to these improvements in design, too much stress cannot be laid on the fact that the using of this process enables the operator to make a uniformly better grade of steel. With means for the regulating both the air and the gas whereby the operator can control the temperature of the furnace and with the intimate premixing of the fuel and air with a minimum amount of excess air, less contamination from the fuel and less trouble due to oxidation of the bath occur and the melter has in his hands an instrument that is thoroughly under his control from which he can obtain the best results possible from the materials charged.

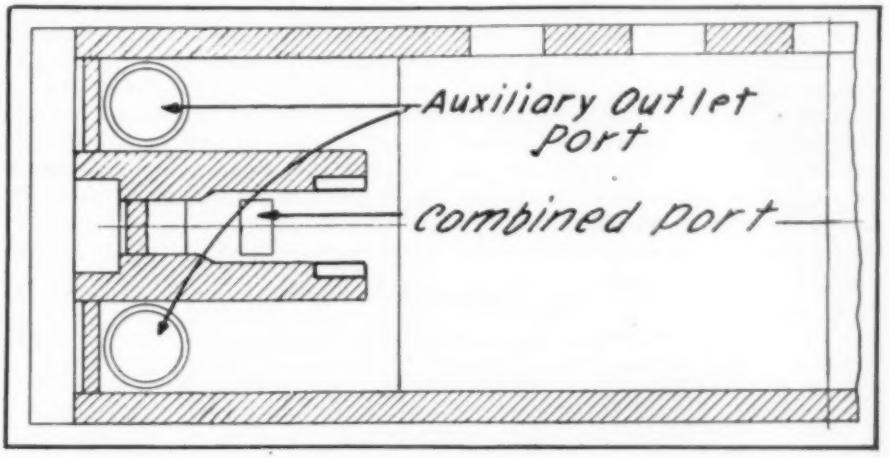


FIG. 3—HORIZONTAL SECTION SHOWING PORT ARRANGEMENT

Due to the fact that the charge is melted down so rapidly, a higher percentage of scrap can be used without the addition of carbon, thus making possible the use of a much cheaper mix.

Other Possibilities

There are many refinements of the blow torch furnace which will be worked out, but the results so far obtained are so remarkable and the correctness of the principle involved has been so universally acknowledged as to insure its rapid introduction. This process of combustion has opened up quite a number of possibilities for the further improving of open-hearth construction which deserves very serious consideration.

In Fig. 5 is shown an open-hearth furnace in which the regenerators are encased with insulating bricks and steel platework. Inasmuch as the use of the

steel platework enables us to use much thinner walls, it is evident that this construction is little more expensive than that which is now used, while the saving due to decreased heat losses is appreciable. Furthermore, the regenerator chambers can be maintained in much better shape and the temperature of the basement is materially decreased, making it much more livable.

A more radical departure is the eliminating of the gas regenerator chambers when using producer gas. It is proposed to locate the gas producers comparatively near to the open hearth and conduct the gas in suitable steel mains, properly insulated, to the ends of the furnace and introduce the gas into the air uptakes without any regeneration. This practice becomes possible only by the use of the blow torch principle, where the air and gas thoroughly mix before they issue from the port so that the resultant temperature of the mixture is the only temperature that needs to be considered. Inasmuch as approximately 800 degrees Fahr. stack temperature is now obtained in a blow torch furnace, it is evident that the temperature of the gases escaping through the air checkers is much lower than those escaping through the gas regenerators, as the incoming gas cannot possibly lower the temperature of the gas checkers below 1050 to 1100. Therefore, it is evident that by making all the gases escape through the air regenerators the temperature of the incoming air will be considerably higher than when the gases are divided and the resultant temperature of the mixture of gas and air will be substantially the same as at present.

Eliminates Gas Loss

This construction appeals strongly to those to whom it has been suggested because it eliminates the gas loss that now occurs whenever the furnace is reversed when not only all the gas from the end of the port back through the generators to the gas valve is lost but with most designs of valves the gas in the mains back to the producers is exhausted by being connected to the stack during reversals. It eliminates the hydrocarbon loss which now occurs in the regenerators and the difficulties due to the clogging of the gas checkers. This construction greatly decreases the volume of the slag pockets and the heat losses due to radiation from the excessive space between the checkers and the ports. Structurally this construction is exceedingly desirable as it greatly decreases the cost of the furnace and shortens the distance required from center to center of furnace by 5 to 10 feet. It also eliminates the center wall in the slag pockets and the need of overhung brickwork in the uptake.

There is no question but that the transition through which the open hearth is now passing will so increase the capacity of existing units that there will be practically no construction of new open-hearth plants required to meet the demand for steel for a number of years, but one of the biggest problems incident to the introduction of the rapidly operated furnace will be to get the raw material to the furnace and to handle the material on the casting side. New plants must be carefully laid out so as to eliminate as far as possible delays due to shop conditions and doubtless existing ones will need to be considerably altered and improved to take care of the additional materials to be handled.

Attention naturally has been attracted mostly to the basic open-hearth furnace, but inasmuch as the saving of time in the process is principally in melting down, at least equal increase in tonnage can be expected in acid furnaces.

While previous inventions in the open hearth have had for their object increasing the comfort of the operators and the decreasing of the shut downs and repairs to

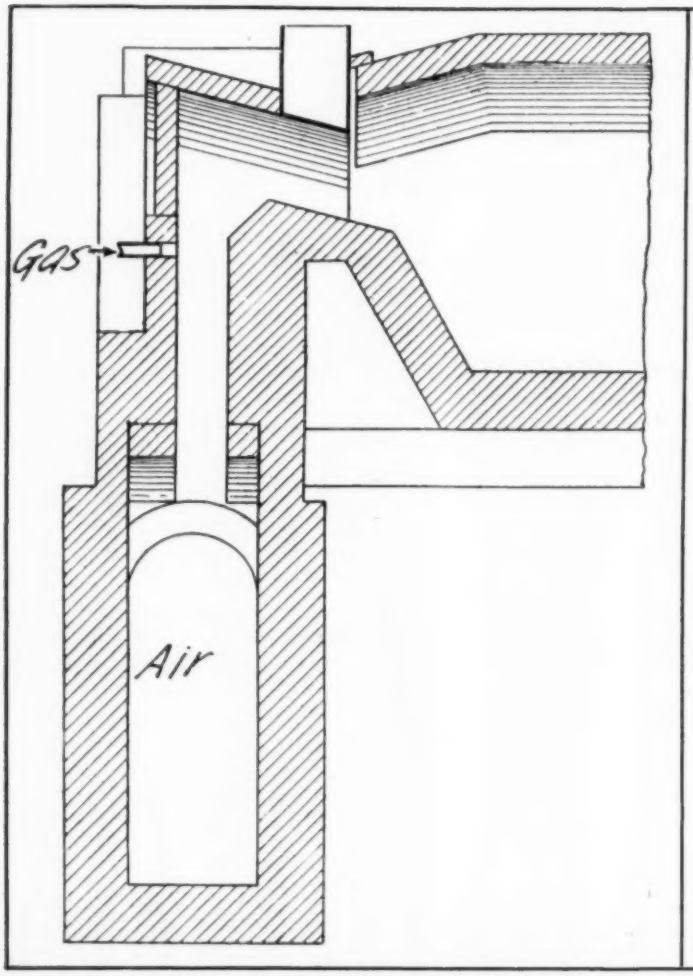


FIG. 4—SECTION THROUGH COMBINED PORT DESIGNED FOR COKE OVEN OR NATURAL GAS

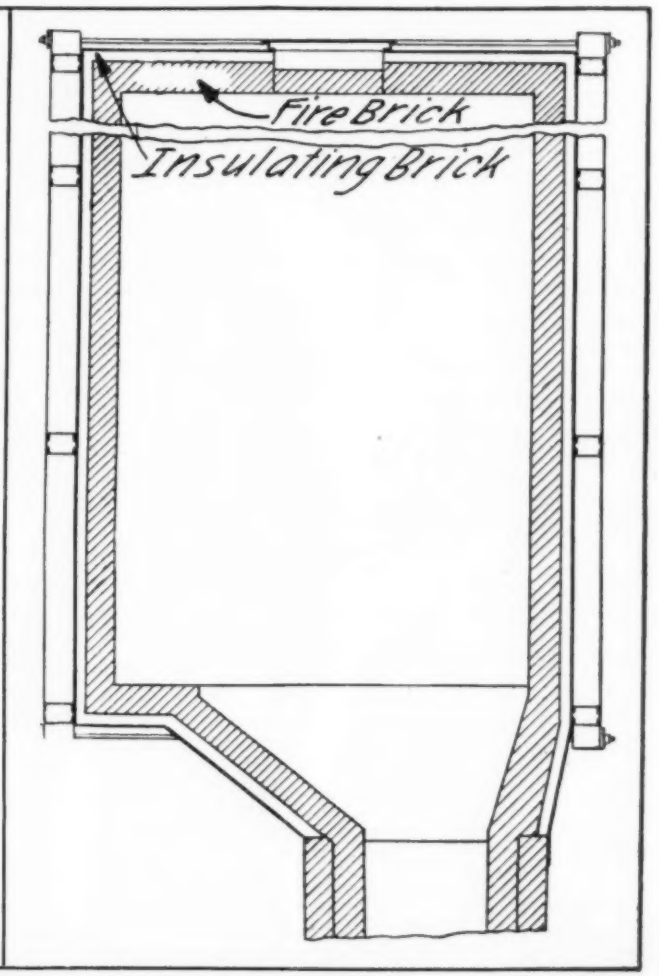


FIG. 5—STEEL ENCASED INSULATED REGENERATOR

the furnace, the effects of this invention are so far reaching that it is difficult to appreciate the magnitude of the development. The principal advantages as have been outlined are

Better steel
Increased fuel economy
Greatly increased output
Longer life of the furnace
Possibility of using a higher percentage of scrap
Decreased plant cost for a given capacity.

By using unregenerated producer gas as proposed, it should be possible to obtain the following additional advantages:

Additional fuel economies
Greatly decreased cost of construction
Simpler construction.

No great invention is ever made that does not require considerable study and the careful co-operation of all interested before the full benefits of such invention can be obtained, so it will be necessary to have the hearty co-operation of engineers and operators before the maximum results are derived with the blow torch furnace. However, the correctness of the principle is so universally acknowledged and the results already obtained are so remarkable as to necessitate its rapid introduction.

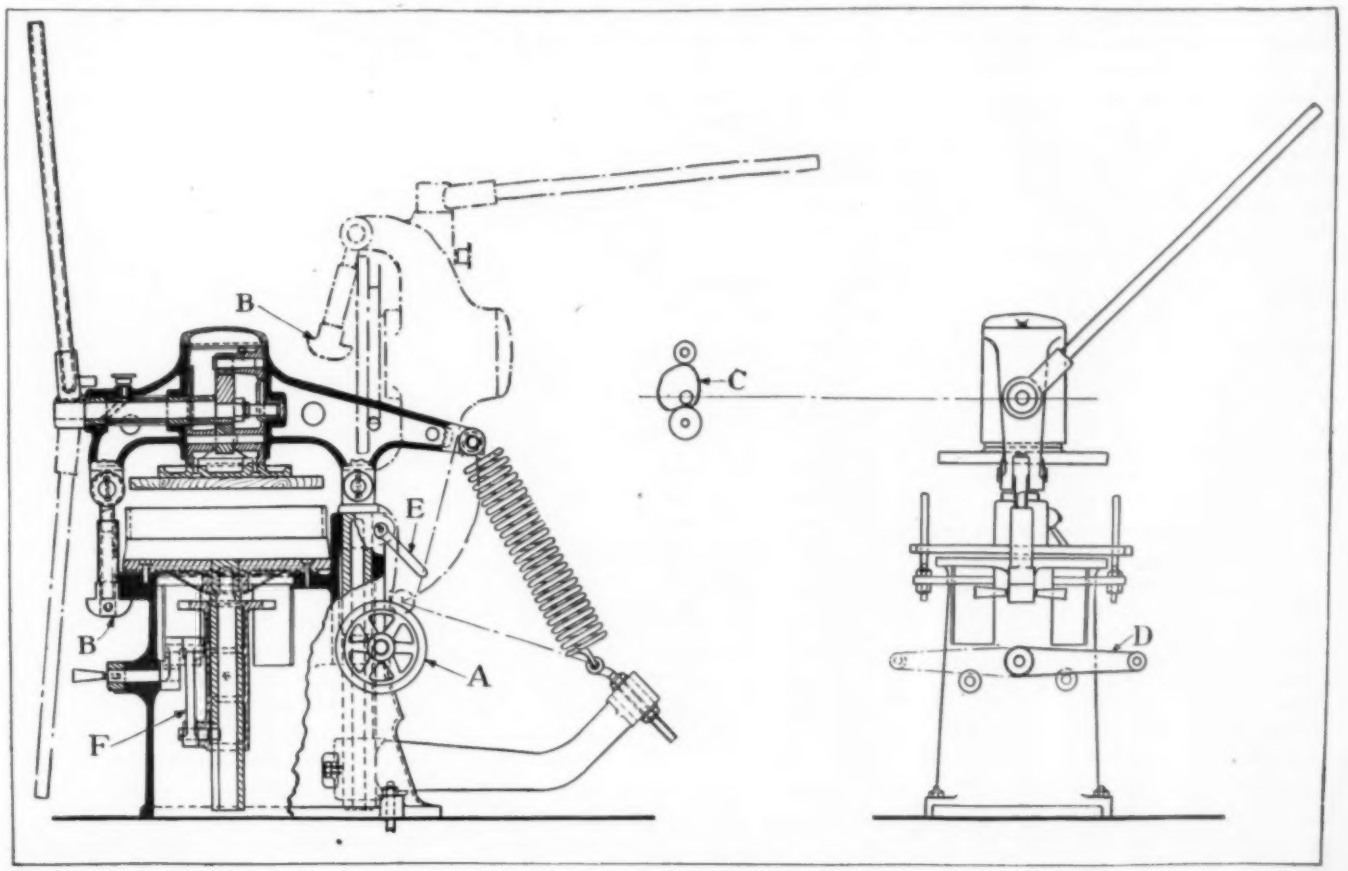
Squeeze Pattern Draw Belgian Machine

THE combined molding and pattern drawing machine shown in the accompanying illustration is made by Societe Belge des Appareils Rateau, Brussels Belgium. The makers claim that no previous experience is necessary to work it, that its cost is moderate and that its maintenance is comparatively inexpensive. In support of the claim the statement is made that three young workmen under 18 years of age working two machines on flasks 18 x 14 inches frequently have obtained outputs of 200 molds in an 8-hour day. Placing the job on a piecework basis is expected to increase the output 50 per cent. The experiments were tried on coreless castings weighing from 10 to 20 pounds each. Thus the output per man ranged from 660 to 1320 pounds of castings per 8-hour day.

The machines at present constructed are provided with platens to accommodate flasks 500 x 500 millimeters (20 x 20) inches). However the dimensions may be changed and adapted to fit other sizes.

The construction of the machine and method of operation are illustrated in the side section and end elevation shown. The spiral spring at the back serves to pull the squeezer head upward out of the way after the flask has been rammed. The ramming head is mounted on a column at the back of the machine. It may be adjusted by the hand wheel *A* to suit flasks varying in height and is locked in any desired position by the lever *E*. The swinging clamp *B* anchors the head in ramming position.

The long lever pulled down sideways as shown in the end view, exerts progressive pressures on the squeezer head through a cam and rollers. This feature is shown at *C* and also in the sectional view at the left. The crank arm and plunger arrangement for lifting the flask off the pattern plate is shown at *F* and the lever which throws it from side to side is shown at *D* in the end view. The machine is substantially constructed and also presents that perfection of surface detail which characterizes Belgian workmanship.



THE LONG LEVER EXERTS PROGRESSIVE PRESSURE ON THE SQUEEZER HEAD THROUGH A CAM SHOWN IN SECTION IN THE ILLUSTRATION TO THE LEFT AND ALSO IN FULL IN THE CENTER ILLUSTRATION *C*

Malleable Iron Metallurgy

High Melting Point Causes High Shrinkage and Cracking—Mixtures Made To Analysis Produce Castings of Definite Composition—Foundries Need Laboratories

BY M. M. MARCUS

MODERN practice in the manufacture of malleable iron castings as controlled by science presents a strong contrast to the methods used in the early stages of the malleable industry. For this reason, some historic points are of interest in approaching the present day malleable problems. The manufacture of malleable iron, strictly speaking, may be said to be confined in this country to the past 20 years. At present about 250 different firms are producing malleable iron and these turn out a yearly total approximating 1,000,000 tons. During the past 20 years malleable castings have replaced gray iron in a number of cases.

Owing to the lower carbon and silicon contents of the malleable mixture, the melting point is considerably higher than in the case of gray iron. Lower phosphorus and manganese contents make malleable iron less fluid than gray iron and therefore the metal must be poured more rapidly and at a higher temperature. The second distinction of importance is the greater liability of malleable iron to shrink and crack. The initial contraction in malleable iron is about double that of gray iron and averages about a quarter of an inch to the foot. On this account unusual care is necessary to avoid shrinkage due to unequal cooling.

The process of annealing causes an expansioin of about one-eighth of an inch to the foot, thus making the final product correspond closely as to shrinkage with the gray iron product, so that the same pattern rules may be used for both classes of work. However, the actual patterns usually differ greatly due to necessity for special gating in the case of malleable castings. As a result it is advisable for the malleable foundry to design the gates of its patterns.

Fluid iron in a mold tends to draw away from the heavier section into the lighter section due to the more rapid cooling in the latter, and this tends to produce cracks at or near the point where the lighter sections join the heavier. The cracks generally show when the casting is first taken from the sand, but frequently cracks do not develop until after annealing. The simplest way to overcome the tendency to crack is by designing the castings with uniform sections, but, of course, this is not always possible. Where abrupt changes cannot be avoided shrinkage may be overcome by the use of chills on the heavy sections, which tend to accelerate cooling, or by using risers on the light sections as closely as possible to the point at which the different sections join. The risers or shrinkage heads should be heavy enough to feed the light sections.

In the production of malleable castings two important items should be considered. First the carbon of the white iron must be in chemical combination and in such combination that it is annealable, and second, the annealing must be such that it will dissociate the carbon in combination as precipitated free carbon. The chemical analysis, the casting temperature, and the rate of cooling are the three main factors that are directly responsible for the proper condition of the carbon for annealing. Other conditions being constant, the higher the casting temperature, and the more rapid the rate of cooling, the greater will be the percentage of combined carbon. The rate of cooling may be modified by a number of factors such as thickness of section, time of dumping of molds, artificial chill and casting temperature.

Chemical Analysis

From the metallurgist's point of view, the most important factor is chemical analysis. The condition of the carbon is largely determined by the inherent relationship of the various elements. By varying the percentage of silicon it is nearly always possible to secure the proper condition of combined carbon, but to do this the carbon must be reduced as the silicon percentage is increased. By varying the elements in their relation one to another, the skilled metallurgist is able to secure a great range in physical property of the product.

Within a quarter of a century pig iron was bought by the fracture almost entirely. If the specimen was heavily mottled, the metallurgist assumed it was high in silicon. If the fracture was white, it was supposed to be low in silicon. Other elements such as manganese, sulphur and phosphorus were practically ignored. Now it is known that the fracture itself is not always a correct criterion. With constant silicon content, iron high or low in carbon will show a different fracture. Foundry iron now is purchased according to definite analysis and is used with scrap of equally definite analysis so that the result is predetermined with surprising accuracy.

The scrap which is usually available in malleable production consists of sprue, hard iron, annealed domestic, annealed foreign malleable, and steel scrap. However, it is not enough to determine the chemical composition of the mixture entering into a melt. Physical properties also have a bearing on the result. Sand coated pig requires a greater length of time for melting, also more chunky pieces require longer time than light pieces. Small light scrap is often badly rusted and this is apt to be detrimental. A normal mixture consists of 50 per cent pig iron, 35 per cent sprue, 10 per cent malleable scrap and 5 per cent steel scrap. A typical analysis for medium sized malleable castings is as follows:

	Per cent
Silicon	1.30 to 1.45
Sulphur	0.055 to 0.065
Manganese	0.50 to 0.55
Phosphorus	0.15 to 0.20
Total carbon	3.00 to 3.20

The percentage of sprue scrap easily can be calculated from the analysis of the different materials which are to enter into the melt if the action of the furnace is known. In starting up a furnace it is often necessary to experiment some to determine the exact furnace action. However, having determined this, the operation follows along fairly well marked paths.

Materials which go to make up a charge are placed in the furnace and melted in the usual way, depending upon the type of furnace. The bottom of the furnace is always made up before charging. When the metal is in the molten state a test is made to determine the percentage of silicon and carbon. It is essential to good castings that none of the carbon should appear in the sample in the graphitic form. The

The author is general superintendent, Rhode Island Malleable Iron Works, Hillsgrove, R. I.

proper analysis at this point, in my belief, is 2.45 per cent carbon and as much silicon as the heaviest section will carry without precipitating graphites.

Sometimes furnaces for no apparent reason will have an exceptionally high run of white iron scrap. In one case this was said to be due to repeated oxidization of silicon during pouring off or tapping, because the metal gets hotter toward the end of pouring, as the volume of metal is lessened as it is drawn from the furnace. A series of tests taken every 30 minutes during pouring off disproved this contention. The cause of the trouble was at some other point in the foundry operation. For general malleable work pig iron is purchased on the following specifications:

	Per cent
Silicon	1.25 to 1.75
Sulphur under.....	0.05
Manganese	0.50 to 0.80
Phosphorus	0.15 to 0.20

Assuming that the loss of silicon amounts to 0.30 per cent and it is desired to have white iron with 1 per cent silicon, then the malleable iron mixture would be figured for 1.30 per cent silicon. This same method is used in figuring the other elements.

An empirical formula for calculating the percentage of manganese has been developed by experiment as follows: Manganese equals twice the amount of sulphur plus 0.15 per cent, for example: If sulphur is 0.08 per cent, manganese should be 0.31 per cent. The loss of carbon amounts to about 0.40 per cent. Thus when it is desired to have a white iron with 2.40 per cent carbon the mixture is figured as 2.80 per cent. The silicon content exerts no influence upon the carbon during the melting. If during the heat a test bar were poured at an early stage the fracture would be gray, because the silicon is high enough to prevent the carbon from remaining permanently combined with the iron after solidification. However, by holding the metal in the furnace, the oxidizing action of the furnace gases gradually lessens the silicon in the bath and a point is finally reached where the carbon will remain in the combined state and a sample then will be uniformly white. When the hard iron castings are poured, the first step in the manufacture of malleable iron is complete. From this point, after proper cleaning and inspection, castings go to the annealing oven.

The present practice in annealing consists of placing castings in cast-iron pots, sealing the joints to exclude air and then placing these in the annealing oven. The oven is then fired slowly until a temperature of about 1550 degrees Fahr. is reached. Here it is held for three days and then is allowed to cool down slowly to about 1000 degrees Fahr., then more rapidly to approximately 200 degrees Fahr. At this latter temperature the castings are pulled from the furnace and allowed to cool.

Malleable castings should be free from blow holes. The metal from which the casting is made should be highly fluid when hot and should have minimum contraction when cooling. The elastic limit should approach the ultimate strength as closely as possible. A fair example is 29,000 pounds per square inch elastic limit and 44,000 pounds ultimate strength. The compressive strength should be high. Castings should have high shock resistance and should be slow to rust. The machining properties should be excellent.

So much can be learned from the use of the microscope and from carefully following the work in a malleable iron plant by chemical and physical tests that it is now common practice to have laboratories in connection with foundries. These laboratories often carry a staff of technical men who conduct individual research in an attempt to secure better castings and more efficient methods of manufacture.

British Specifications for Malleable

THE castings to be of *black heart* or other approved *malleablized* material. To be well annealed, sound, clean, and free from blow holes and to be to the satisfaction of the inspector.

Tests

Sound samples for testing to be provided shall have the following dimensions in the finally annealed condition:

Bend Test Samples—1 x ⅜ x 6-inch.

Tensile Test Samples—The dimensions of these bars should be varied according to the average cross sectional dimensions of the castings to which they are attached, as shown in the accompanying illustration.

One bend and one tensile test bar to be cast upon each casting which weighs 100 pounds or over.

Castings individually weighing between 28 and 100 pounds to be grouped in fours, and there shall be cast upon one casting of each group one bend and one tensile test bar.

Castings individually weighing less than 28 pounds to be grouped in lots of 2 cwts. (224 pounds), and there shall be cast upon a pair of castings in each group one bend and one tensile test bar, or four test bars per each 2 cwts. of castings.

Hammering Test—Each casting to be subjected to such hammering tests as the inspector may consider necessary to prove the soundness and efficiency of the casting for its intended purpose.

Destruction Test—The inspector may substitute for the above sample test bars a test to destruction of a casting, or the cutting up of a casting for bend or tensile tests. Also he may, at his discretion, select castings and test them to destruction with a view to ascertaining the fitness of the castings for the service intended.

Tensile Tests—The material used in the castings must have a tensile strength of not less than 20 tons (44,800 pounds) per square inch, a yield point of not less than 9 tons (20,160 pounds) per square inch, with an elongation of not less than 5 per cent, taken on a distance between gage points (marked *B* on the accompanying illustration) as given by the formula:—

Length between gage points (in inches), 4 x $\sqrt{\ }$ area tested (square inches).

Bend Test—The test bar 1 x ⅜ x 6-inches, to stand bending cold over a radius of ½-inch through an angle of 45 degrees without sign of fracture, the test bar

Contrast of the British and American view points is illustrated by the specifications published here. In contrast with the attempt at simplification in the American specifications which make only one classification of all malleable castings is the division into seven classifications by the British specifications, each requiring a different length of parallel sides in the bar and a different gage length. Also a bend test is required by the British while the elongation in the tensile test is used by the Americans as an indication of ductility. Possibly the most serious difference is the shape of the test bar which should be the same in both specifications if the two irons are to be compared.

Specifications for malleable cast iron for admiralty purposes, recently issued by the British Cast Iron Research association.

	Inches A	B
Extra Light Castings Average thickness under ¼ inch (C)	3	2
Light Castings Average thickness ¼ x ⅜ inch.	3	2½
Light Medium Castings Average thickness ⅜ to ½ inch	3½	3
Medium Castings Average thickness ½ to ⅝ inch	4	3½
Medium Heavy Castings Average thickness ⅝ to ¾ inch	4	3½
Heavy Castings Average thickness ¾ to 1 inch	5	4
Extra Heavy Castings Average thickness over 1 inch..	5½	4½

being flatwise of the 1 x ⅜-inch section.

Condition of Test Bars—In all cases the test specimens shall be annealed with and shall receive the same heat treatment as the castings they represent. The test bars to be cast without using chills. The gage length of the tensile pieces shall be marked on the unmachined bars and it is understood that both tensile and bend test bars shall be tested in the unmachined condition. There will be no objection raised to a slight filing of or rounding of the sharp edges of the bar corners, up to 1/16-inch radius, otherwise the dimensions given for tensile and bend test bars are cast sizes and must be adhered to. Where test pieces are cut from a casting the dimensions of such should correspond as nearly as possible to those of the cast test bars as above specified.

Memorandum

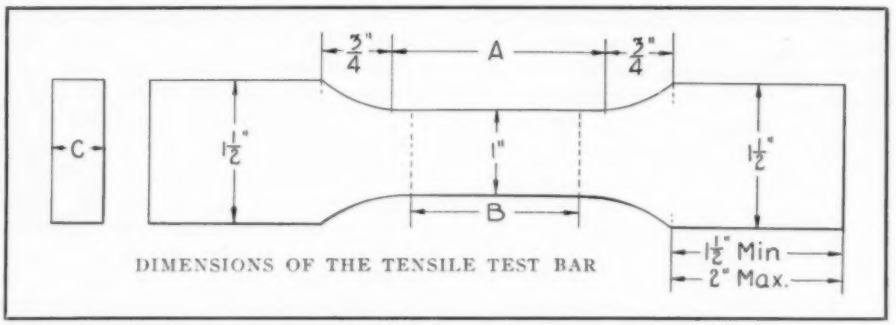
While not desiring the insertion of the following recommendations in the specification, the Association feels that consideration should be given to:

Such cases where, owing to the lightness of section or other difficulties in casting, it is not practicable to cast test pieces upon the castings.

Here separate test bars should be cast at the same time as the castings represented by such tests and annealed with them to represent actual conditions.

The breaking up of castings for tests—In many instances the cost of such destruction tests is considerable, and it is thought that the makers of the castings so tested should be paid for all castings so destroyed.

The hammering tests—It is advisable that extreme care should be taken in carrying out such tests, especially in the case of thin walled and intricate castings. In view of recent researches, calling attention to the serious stresses which can be locally set up by impact or restricted areas, such as may be the case in hammering thin castings it is thought desirable to point out the possible danger of drastic hammering tests.



DIMENSIONS OF THE TENSILE TEST BAR

Firm Conducts Cast Iron Grinding Tests

BY A. W. FORBES

GRINDING wheel manufacturers recommend carbide of silicon wheels for grinding cast iron, but the results of some practical tests conducted recently at the plant of Forbes & Myers, Worcester, Mass., manufacturers of electrically driven grinders revealed that an alumina abrasive showed the highest efficiency. Five wheels, designated by the numbers 1, 2, 3, 4 and 5 in the accompanying table, were tested on a swing-frame grinder for grinding cast iron. When the results were compared it was revealed that in every test the alumina abrasive showed the most efficient results. The table indicates that the alumina abrasive wore away faster than some of the carbide of silicon wheels while it outlasted others. The factors entering into the test included the weight of the castings in pounds before grinding, amount of material removed in pounds, the wheel loss in ounces, time consumed in grinding, pounds of material removed per hour, the cost of grinding allowing $1 per hour for labor per pound of metal removed, the cost of abrasive material per pound of material removed and the total cost of grinding per pound.

Results of Practical Grinding Tests

Wheel test number	1	2	3	4	5
Grit	20	24	30	20	24
Grade	Q	P	M	Q	P
Abrasive	Carbide of silicon	Carbide of silicon	Alumina oxide	Carbide of silicon	Carbide of silicon
Weight of casting, in pounds	90.5	89.7	85.5	90	91.5
Material removed, in pounds	1	1	1.2	1	0.5
Wheel loss, in ounces	2	0	0.5	0.5	0.5
Length of test, in minutes	46	49	34	31	20
Pounds of material removed per hour	2.2	2	3.5	3.2	2.5
Cost of grinding at $1 per hour per pound of metal removed	$0.45	$0.50	$0.29	$0.31	$0.40
Cost of wheel wear per pound of material removed	$10.09	$0.00	$0.01	$0.02	$0.04
Total cost per pound	$0.54	$0.50	$0.30	$0.33	$0.44

The author is one of the firm of Forbes & Myers, Worcester, Mass., manufacturers of electrically driven bench, floor and hand grinders.

Studies Changes in Grain Size

(Concluded from Page 987)

stretch of the imagination is necessary to see in the first marked coating of the grain; and in the second, fragments of that coating broken from the grains.

Since, during the entire experiment, only clay and water were added to the pure silica sand, the change in the shape of the grains can be due only to a deposit of clay, which, in the presence of water, may possibly hold small grains of sand; and furthermore, the fragments shown can be nothing but parts of the deposit removed.

Requested by fellow members of the technical committee of the Electric Steel Founders' Research group to explain the steadily increasing openness of his facing sand, described in the early part of this paper, the writer on several occasions advanced the snowball theory. However, he could not prove that theory true until the conclusion of these experiments.

How Sanitary Ware Is Made--II

Some of the Features Involved in Applying the Enamel—Monorail System and 4-Spout Ladles Greatly Reduce Time and Effort Required To Pour Off Floor of Soil Pipe Castings

BY PAT DWYER

BATH tubs are enameled in the building shown in Fig. 1. The doors to the heating furnaces may be seen in the wall to the right of the illustration. Smaller articles, sinks, lavatories, washbowls, tanks, etc., are enameled in an ell opening into and adjoining the main building to the left. Porcelain enamel used as a coating on cast-iron sanitary ware is a form of glass and, in fact, while it is being prepared it is known as glass. In applying it to the castings two distinct mixtures are used, the first is known as the slush, or wet coat, and the second is the enamel itself, or the finishing coat. The slush is the base which binds the enamel to the metal. The ingredients must, to some extent, unite with the metal itself and not act merely as a glue. Manufacturers of sanitary enameled ware have developed individual formulas for their slush coat and finishing enamels, and while general knowledge on the various ingredients employed is common, still the proportion in which these ingredients are mixed is regarded as private and information on this phase of the subject is not available.

The slush coat, as the name implies is a liquid, gray in color and about the consistency of claywash. Formerly it was applied to the castngs by an operator who dipped it out of the tank in a cup and threw it over the surface, but recently a spraying apparatus has been adopted for the same purpose. The spraying device is more efficient in that it distributes the material more uniformly, and therefore a smaller quantity of slush serves to cover a given area. In addition, the method is considerably faster, especially on bath tubs and other large castings. After the slush has been applied the casting is set to one side and allowed to dry thoroughly. Pin holes and other minor surface defects are touched up by the enameler before the casting is placed in the furnace.

Maintaining the proper temperature to melt the slush coat fast enough to make it unite with the iron is one of the difficult features in the sequence of operation. If the furnace is too hot it will burn off the slush and the enamel will not adhere to the iron. After the slush coat has dried the tubs are wheeled in on trucks and placed near the heating furnaces. Six furnaces are provided, but since the equipment and method of operation is the same in all cases this description will be confined to one casting and one furnace.

The device and method of handling the tub in the annealing room are shown in Fig. 1. A long fork made from a 20-foot length of 3-inch pipe, provided with a T-handle at one end and a fork at the other end is employed for lifting the tub into and out of the furnace and also for lifting it into and out of the frame where it is manipulated while the finish coat of enamel is being applied. The pipe is suspended from a swinging jib crane at a point near the fork and with the leverage obtained by this arrangement one man readily can handle tubs weighing 250 pounds. The casting must be handled rapidly and accurately after it has been heated and this would be impossible if the operator was burdened with any appreciable weight.

The tub is supported in the furnace on two rails which help it to retain its shape even when raised to a high heat each time the slush or enamel coats are melted down. Special devices are employed in other furnaces where smaller castings are heated preparatory to enameling.

After the slush coat has melted, the tub is taken out of the furnace and placed on the stand shown in Fig. 5 where by a ball joint and suitable gearing controlled by the hand wheels shown to the right, the tub may be tilted to practically any position. The tub is set in a steel casing or frame attached to the table and is held there by its own weight. Two men apply the enamel, one man standing on each

FIG. 1—IN THE ENAMELING ROOM THE BATH TUBS ARE HANDLED BY A LONG 3-INCH PIPE PROVIDED WITH A FORK AT ONE END AND A T-HANDLE AT THE OTHER END—THE DEVICE IS SUSPENDED FROM THE END OF A WALL JIB CRANE

side of the table. The tub is tilted into many positions to enable the men to apply the enamel evenly all over the surface. When the casting is entirely covered, the table is returned to a horizontal position and the tub is lifted out of the frame and placed back in the furnace. Usually two or three coats of enameling powder are applied, the tub being heated after each coat. When finally the tub is removed from the furnace it is inspected and, if found satisfactory, is conveyed to a room where it is allowed to cool slowly.

Enamel for the finish coat is applied in the form of a fine white powder sifted through a 40 to 60-mesh screen mounted on the end of a long handle and actuated by a vibrator. The long handle enables the operator to stand back a comfortable distance from the red hot casting and thus he is in a favorable position to guide the sifter over the surface of the casting while the vibrator shakes down the powder. The casting is heated to 1800 degrees Fahr. to melt down the ground coat, and a temperature of about 1100 degrees is required to settle the finish coat. The time required to heat the castings depends on their shape and size and will vary from 2 or 3 to 15 or 20 minutes.

Soil pipe over 6 inches diameter is made in the same building as the bath tubs. One of the floors is shown in Fig. 2 with a typical machine and pattern in the foreground. One machine will serve to make several sizes by changing the pattern and stripping plate. The men working on this floor also make the iron flasks required both in this foundry and the other foundry devoted altogether to the manufacture of soil pipe castings.

The soil pipe foundry approximately 300 x 200 feet, is amply lighted and ventilated through a swinging sash which constitutes the greater part of the side and end walls and also both sides of the monitor roof. A space about 60 feet wide across each end of the shop is given over to the production of fittings, elbows, tees, bends, etc., and with the exception of two main central gangways, one extending longitudinally and the other transversely, the remainder of the floor space is taken up by 24 long floors on which the straight sections of pipe are made. The general appearance of the floors may be noted in Figs. 7 and 8 where it will be seen that there is no crowding and a generous space is provided between the rows of molds.

The cupola is located at one side of the shop and at one end of the central gangway which extends from one side of the shop to the other. The metal is delivered to the various floors by a monorail system which may be seen in several of the illustrations. Owing to the peculiar land formation, the cupola charging platform is on a level with the stockyard where a locomotive crane unloads all material, pig iron, scrap, coke and limestone from the cars. Concrete sand bins, with open tops level with the yard and with doors on the lower inside leading to the foundry floor, have been constructed in the same bank a short distance from the cupola and at a point where the locomotive crane can transfer the sand from the railroad cars to the bins with a grab bucket.

While the floor of the foundry is approximately level, concrete foundations laid flush with the floor, 1 foot wide and 3 feet 6 inches apart, insure that the row of molds will lie perfectly level and at a uniform height. This uniformity is essential on account of the fact that the ladle is suspended at a definite distance from the monorail and is not equipped with a hoisting device. The ladle will pour from eight to ten molds and when the character of the castings is taken into consideration it is apparent that it must be handled rapidly. No time is available for adjustment.

In addition to serving as a permanently level foundation on which to lay down the flasks, the long parallel concrete walls maintain the molds in a central straight line under the monorail. The walls project about 2 inches above the surrounding sand floor and therefore an open space is provided under the greater part of each drag and gives free egress to any steam generated during the pouring process. The sides of the flasks are tapered, and with bars in the drag the same as the cope, it has been found that no bottom plates are required on the drag.

The smaller size pipe patterns, 2 to 4 inches diameter, are mounted in pairs on machines similar to the one shown in the center foreground Fig. 7. This machine is mounted on wheels and is moved along the floor from one end to the other, commencing at opposite ends on alternate

FIG. 2—SOIL PIPE PATTERNS FOR ALL SIZES OVER 6 INCHES ARE MOUNTED SINGLY

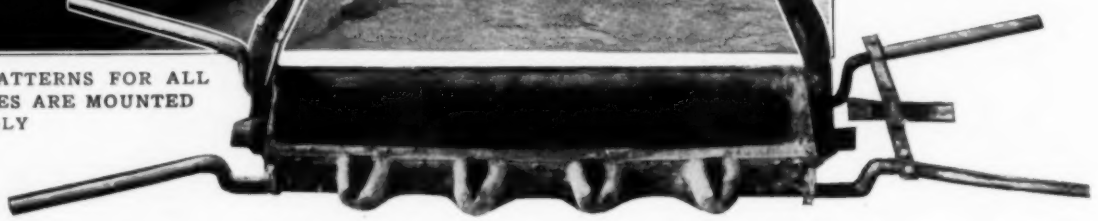


FIG. 3 — BELOW — THIS LADLE WITH FOUR SPOUTS HANDLED BY TWO MEN IN ONE TRIP FROM THE CUPOLA POURS AS MANY FLASKS AS FOUR MEN FORMERLY MAKING EIGHT TRIPS WITH HAND LADLES

days. Two men work on each floor and put up an average of 39 flasks, 78 castings, every day. That includes making both molds and cores, setting the cores, closing the molds and pouring them, shaking out the flasks, removing the arbors, carrying the castings to the central gangway and cutting the sand.

The patterns are complete pipes, considerably thicker than the castings, accurately machined all over, and mounted on the machine in such a manner that exactly one half the circle projects above the stripping plate. A hand lever on the outside and a cam attachment on the inside serve to drop the patterns about ½-inch before the flask is lifted off. On account of the shape and the generous draft allowed on the ends a ½-inch drop affords all the clearance required. The same patterns and pattern plate serve to make both cope and drag. The only change necessary is to set the gates and runners when making the copes. This part of the pattern equipment is detachable and is omitted while making the drags.

All the cores used in this foundry, whether in straight sections or in special fittings, are made in green sand. The straight cores are swept on arbors and the irregular shaped cores are made either in hinged cast-iron coreboxes or inside the same pattern employed to make the mold. Extra heavy 1-inch steel tube with a cast-iron enlargement on the bell end is used for an arbor in the 2-inch straight pipe. The other sizes are made on cast-iron arbors similar to those shown in Fig. 6. These arbors present a corrugated exterior which helps the sand adhere to the surface. A single row of vent holes is provided in each barrel and by a suitable mark on the end of the barrel, the molder can set the core in the mold in such a position that the vent holes are on top.

Several coremaking stands are shown in Fig. 6. One of these stands forms part of the equipment of each floor and is situated at the end adjoining the central gangway leading to the cupola. The sand employed in making the cores receives no special treatment and is the same as that used for making the molds. A sufficient quantity of new sand is added from time to time to give it the proper bond, but the aim is to keep it as *open* as possible consistent with adhesiveness that will prevent it from falling off the barrel. The barrels are machined accurately at each end to fit in the journals of the core machine and later in the open ends of the flasks. A collar on the bell end serves as a stop or guide in locating the barrel longitudinally.

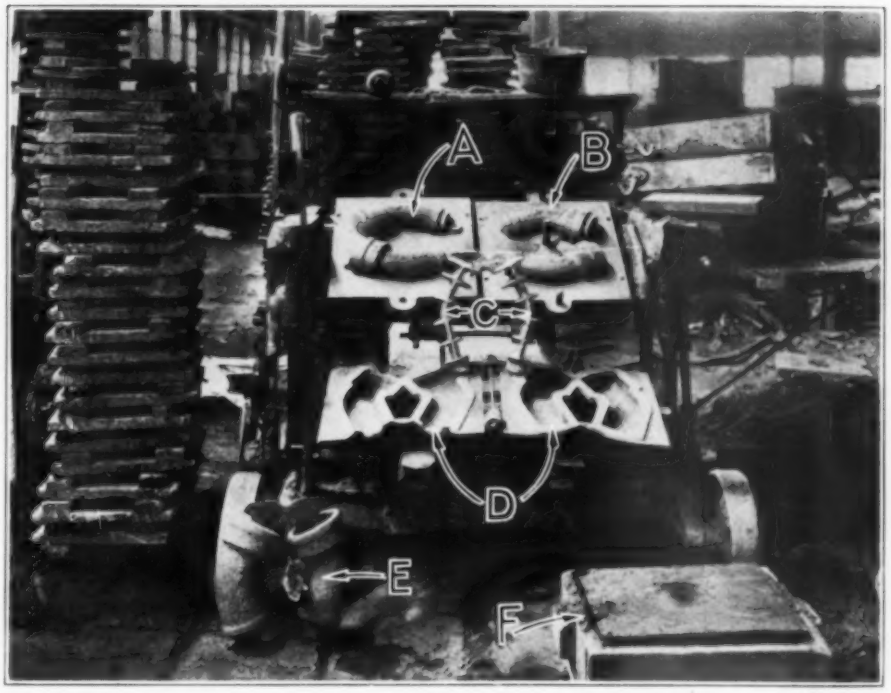


FIG. 4—PATTERN AND COREBOX EQUIPMENT FOR MAKING SMALL BENDS

In practice the barrel is claywashed and placed on the stand. One man inserts a tapered plug provided with a crank handle into the large end of the barrel. The second man throws one or two shovels of sand up into a rectangular riddle suspended above a hopper and narrow, elongated chute situated directly above the barrel. The first man turns the barrel while the second man agitates the riddle with a handle provided for that purpose. The falling sand strikes the revolving barrel with sufficient force to attach itself firmly and uniformly all over the surface. A strike attached to the stand at the proper distance shaves off the superfluous sand and imparts a smooth and correct shape to the core. Each man then inserts a short length of ¾-inch pipe in his respective end of the barrel, lifts it out of the stand, sets it in the mold.

A typical outfit for making many of the small shapes is shown in Fig.

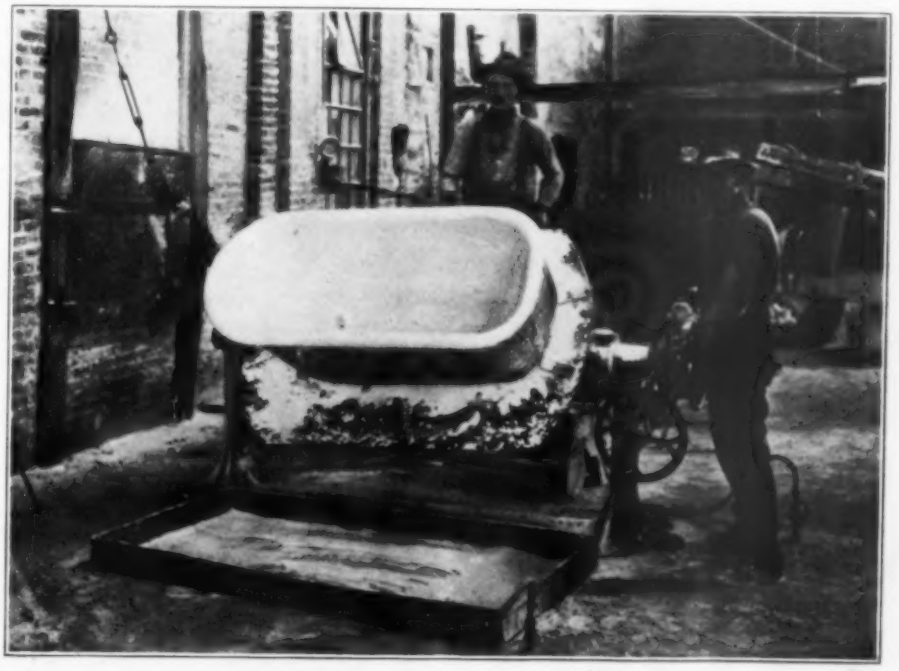


FIG. 5—THE RED HOT CASTING IS PLACED ON A STAND WHICH CAN BE TILTED TO ALMOST ANY POSITION WHILE THE MEN ARE SIFTING ON THE POWDERED ENAMEL

4. The molding machine is a hand-power, pattern-draw, squeezer made by the Arcade Mfg. Co., Freeport, Ill. The mold is made in a snap flask and both cope and drag are rammed simultaneously on the two pattern plates *A* and *B*. The arbor is shown at *C*, the hinged corebox at *D*, the casting, as it appears on leaving the mold, at *E*, and one of the molds at *F*. It may be noted that by mounting the two bends on the same plate and by providing a core arbor of the shape indicated no chaplets are required to hold the cores in their places. The *lift* on one core counterbalances that on the other. In making the core, the corebox is placed on a suitable bench and opened out as shown in the illustration. The arbor is clay-washed and pressed into a thickness of sand covering the bottom of the drag, or left hand half of the box. Additional sand is added and pressed down with the fingers and then scraped off flush with the joint. The cope, or right hand side of the box then is filled with sand, pressed down and scraped off. Then the two halves of the box are raised to a vertical position until they meet. The combined box, drag side down, is lowered back on the bench, the cope half swung up and back and then the core is lifted out of the drag half. The arbor is exposed at each end to afford the molder an opportunity of grasping it. With good equipment, accurately fitting patterns, coreboxes, flasks, etc., no great degree of skill is necessary on the operator's part in making the molds, but a nice sense of touch, which takes some time to develop, is required in making the cores. If the sand is rammed too hard, the metal will blow and produce blisters along the top of the casting and if the sand is too soft, the core either will fall apart, or if it does stand up until the mold is filled with iron, the casting will be over weight.

Shell Patterns

On many of the larger size fittings the pattern serves both for pattern and corebox. The pattern in these cases is an exact duplicate of the casting, plus shrinkage. It is split longitudinally through the center and is provided with dowels so that the halves may be assembled in their proper relative position. In making a mold from one of these patterns the drag half of the pattern is laid upon a followboard provided with blocks corresponding to core prints. The drag is rammed and rolled over and the followboard is removed. Parting sand is rubbed on the core prints after which the arbor is claywashed and rubbed down to a bearing in sand riddled over the bottom of the pattern. Additional sand is added and rammed until the pattern is filled to the joint line. The dowel holes are cleaned out and the cope half of the pattern is set in place. Sand is pushed in through the open ends and rammed until the pattern is filled. A small mound is built at each opening to serve as a core print and then the cope flask is set on and rammed full of sand. The cope is lifted off first and set down, then the cope half of the pattern is removed from the core. The core itself is lifted next and set down on a suitable stand that will engage the arbor at the various points where it projects beyond the sand. The drag half of the pattern is drawn last and after any necessary finishing or patching the core is returned to place, followed by the cope. On the larger pipes the arbor projects through openings in the joint of the flask and after the flask has been closed and clamped the molder taps a wedge in between the upper surface of the arbor and the cope wall immediately above it. This precaution prevents the core from rising while the mold is filling with iron.

Crane ladles holding approximately 1000 pounds and suspended from a monorail are employed to convey the iron from the cupola to two ends of the foundry where the fittings are made. Here it is transferred to hand ladles and poured into the waiting molds. Specially shaped ladles, provided with four spouts similar to that shown in Figs. 3 and 8 are employed for pouring the straight lengths of pipe. They are filled directly from the cupola spout and are handled so rapidly that there is no appreciable drop in temperature between the first mold poured and the last. Each ladle will pour from eight to ten molds. As nearly as possible the ladles are sent in rotation to the various floors. This arrangement provides resting periods for the men, evenly distributed, and also prevents congestion in any one section of the foundry. Formerly it was customary to pour these castings with four hand ladles, and with iron caught directly from the spout. The pairs of men from ad-

FIG. 6—A COREMAKING STAND IS PROVIDED AT THE END OF EACH FLOOR WHERE THE GREEN SAND CORES ARE SWEPT ON CAST IRON BARRELS

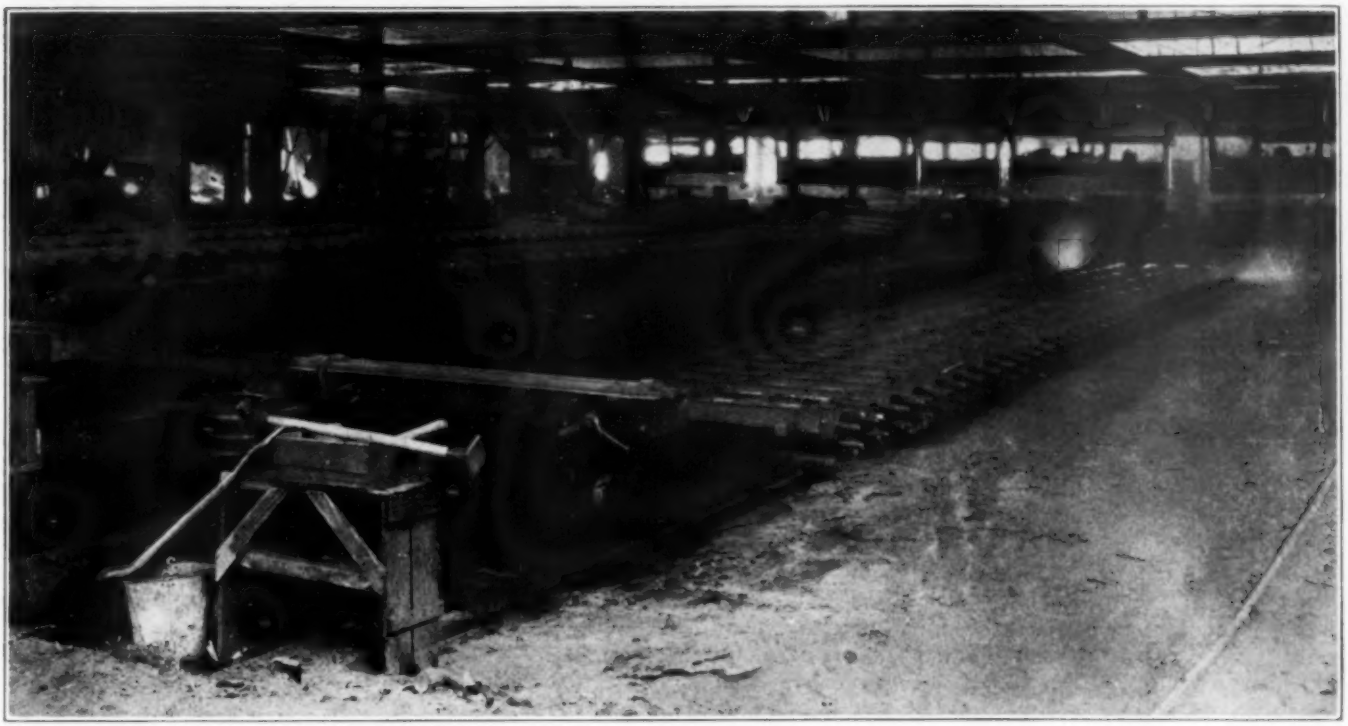


FIG. 7—THE MOLDS ARE LAID DOWN IN STRAIGHT ROWS ON CONCRETE FOUNDATIONS WHICH MAINTAIN THEM AT THE PROPER HEIGHT FOR POURING

jacent floors helped each other. It was hard, heavy work, involving from 75 to 80 trips to and from the cupola for each man. With the 4-spout ladle, each pair of men pour their own floor and only make four trips to the cupola, and besides they only have to tip the ladle instead of, as formerly, both carrying the ladle and tipping it.

Among other minor details incident to standardized routine production is the device for clamping the flasks before they are poured. A clamp shown in Fig. 9 and corresponding to two wedges pointing in the same direction and attached to a permanent back is employed. A slight tap of a hammer is all that is required to either tighten these clamps or to knock them off.

The castings are cleaned in a battery of tumbling barrels and then given a hydrostatic test by placing them one at a time between a base and an upper cap and admitting water

FIG. 8—A MONORAIL SYSTEM EXTENDING OVER EVERY FLOOR GREATLY FACILITATES POURING AND RELIEVES THE OPERATORS OF WHAT FORMERLY WAS THE MOST EXHAUSTING FEATURE OF THE DAY'S WORK

at a pressure of approximately 100 pounds. This is 50 pounds in excess of the minimum pressure prescribed by the American Society for Testing Materials for castings of this character. After the castings are tested they are heated to a temperature of about 300 degrees Fahr., then picked up, twelve at a time in a rope sling, and lowered into a tank full of pitch at the same temperature. They are raised and lowered several times to insure a thorough coating and then carried by a conveyor to a point over a second tank where the surplus material drains off. After they are dried they are stacked in the yard ready for shipment.

The melting equipment in the soil pipe foundry is almost similar to that in the foundry described in the previous article. The cupola is 60 inches inside the lining and the blast is furnished by a positive-pressure blower, belt driven from a 50-horsepower motor. About 50 tons of iron are melted daily, made up in 4000-pound charges, half pig and half scrap, and with a coke ratio of about 1 to 7. A second cupola is in course of erection along side the first. This will be lined to 90 inches and will therefore be able to take care of a considerably increased tonnage. Two charging doors, set flush with the charging platform, are provided in the present cupola and since, as already explained, the charging floor is on a level with the stockyard, there is no need of piling material on the charging floor. A platform scale is placed close to the entrance to the charging platform and the men wheel their barrows over the scale, then to the charging doors, and throw the material into the cupola. The number of men required is based on the speed of melting.

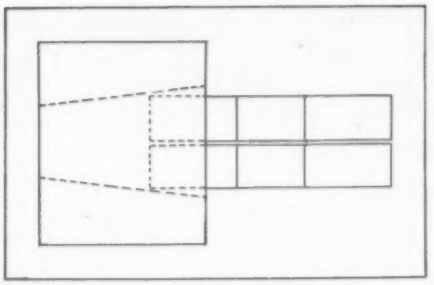


FIG. 8—CAST IRON ONE-PIECE CLAMPS ARE SLIPPED ON THE FLASK LUGS

No attempt is made to keep a close physical and chemical check on the castings, either through the medium of tensile or transverse tests or analysis. The only factors that are taken into consideration are weight, thickness, ability to withstand hydrostatic test and accuracy of dimensions. Pig iron and scrap are purchased according to market conditions and melted in proportions which according to the judgment of the foundry superintendent will produce castings to fulfill the foregoing conditions.

Presence of Mind Needed in Emergency

BY THOMAS NELSON

INSTANT decision followed by prompt action at times in the foundry saves castings that apparently are headed for the scrap pile. A certain amount of deliberation may be permissible during the construction of the mold; but usually, no pause or change in plan is feasible after the metal starts to flow from the ladle. The time required to fill a mold is so short and the metal loses its fluidity so quickly that the fastest kind of co-operation is required between hand and mind if the operation is interrupted. Following instances from the writer's experience are cases in point:

Big Donal and I were doubled up on a job, coring, closing and pouring molds for aluminum castings. He held the double end and I held the single end of the shank. One of the molds required more than the ordinary amount of metal to fill it, which, of course, indicated that we had forgotten to set any core. I mentally set it down as another casting gone to the melting pot, but Donal had other views. He dropped his end of the shank, lifted the cope and set it down, then picked up the drag and spilled the still molten metal back into the crucible, thus saving both mold and metal.

While pouring a mold with a 3-ton double geared ladle the gear housing slipped down on the bail before the ladle was half emptied. The wheel then was jammed and could not be turned any further in that direction. Both wheels were feeding in and the edge of the housing came between the teeth. Throwing the wheel the other way I found that the gears traveled in the other direction and automatically kicked the housing out of the way. It only was the work of a few seconds to turn the ladle end for end and pour the remainder of the metal out of the other lip. The casting was perfect.

The clutch controlling the hoisting gear on an old fashioned steam crane slipped out after about 1 ton of iron had been poured from a 10-ton ladle. Fortunately the ladle fell on a soft sand bed and remained upright. The crane man became excited and did not know what to do. Instead of shouting at him and thus rendering him worse the foreman simply said: "What's the matter Jim?"

The quiet tone steadied the man. He said the clutch had come out and his foot had slipped on the brake before the could catch the load.

"Shove her in again," said the foreman, in the same even manner, "and take her up as fast as you can."

Beyond restorting the man's confidence the advice was not needed. He shoved in the clutch and whipped the ladle off the ground so fast that the lip was over the runner by the time the men were ready to continue pouring. The casting was of fairly heavy section, the metal was good and hot and the hiatus in pouring produced no ill effects.

Quad Foundrymen Hear Cast Iron Talk

The third meeting of the Quad City Foundrymen's association was held at the Davenport chamber of commerce Monday, Nov. 20. A permanent organization was formed and the members adopted a constitution and by-laws as recommended by the constitution and by-laws committee.

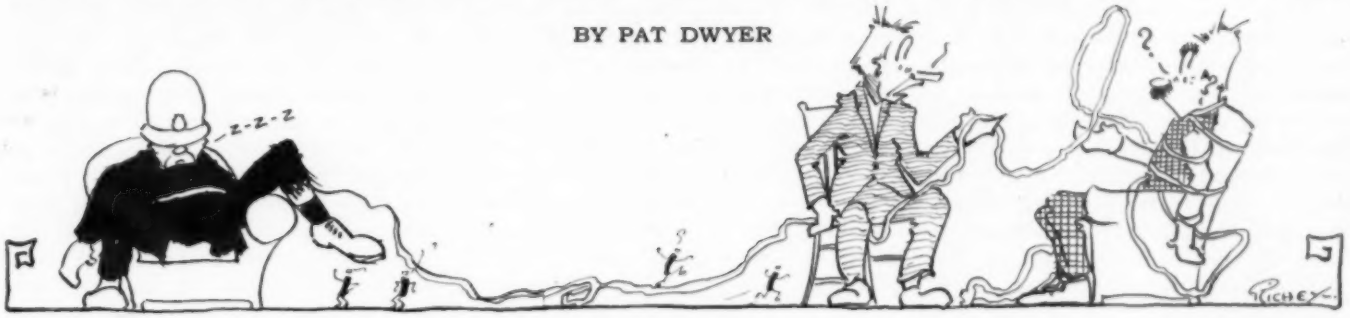
Henry Bornstein, chief chemist of Deere & Co. gave a talk on "Chemistry and Cast Iron." This was followed by a lengthly discussion. The meeting was closed at 10 o'clock, which has been decided upon as the proper closing time. The next meeting is to be held in Moline at the new LeClaire hotel, Dec. 18.

Brass Founders Hear All About Profits

The Metropolitan Brass Founders' association held a well attended meeting at the Building Trades club, 34 West Thirty-third street, New York, Nov. 8. W. L. Churchill, industrial engineer, 300 Madison avenue, New York, addressed the association on operating foundries at a profit.

Bill Comments On the Law Of the Land

BY PAT DWYER



FOR want of something better to engage our attention one night recently, Bill and I discussed the various phases of a gory murder case that occupied front page space in the papers for over a week. Every day the police continued to discover fresh clews which they refused to divulge lest the guilty party should become suspicious and escape before they had him, her, or it, in the toils. Finally, after all the clews had been collected, or after the available supply had been exhausted in the vicinity they decided to conduct an intensive campaign along another line. Instead of picking up a clew and then working backward in the orthodox manner until they were in a position to confront the miscreant with the button torn from his vest and found tightly clenched between the teeth of the victim, they adopted the original idea of putting the burden of proof on the entire village. Commencing at one end of the main street they arrested every man, woman and child in regular order as they went along and made them present a perfect alibi. The net result up to the present writing is that each person interviewed has made affidavit to the effect that he, she, or it as the case may be, was either—(a)—in bed when the crime was committed, or—(b)—walking past the scene of the crime about 1 a. m. and saw a person against whom the witness had a grudge, do the foul deed and then hurry away. After the police discovered that at least a dozen persons were guilty of a murder that bore every evidence of having been committed by one person they began to get a little suspicious that instead of the truth, the whole truth and nothing but the truth, these witnesses were giving them scripture measurement, a great deal more than the truth. "If they ever do find the criminal," said Bill, "which is doubtful, "I can see where the case will be dragged along from one court to another for six months, or longer if the defendant has any more money, and then he either will be discharged, or sentenced to pay a fine of not less than $10 or not more than $15 for carrying concealed weapons."

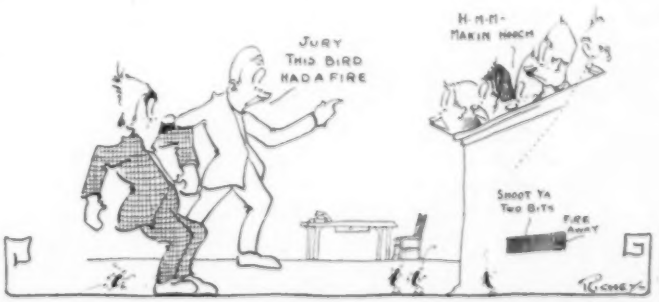
"Do you know," I said, "sometimes I think that instead of having too little, we have too much law. It has become so ponderous and unwieldy and presents so many ramifications that it no longer serves its own purpose. Instead of being regarded as a means of administering justice, it is looked upon as a game by those who practice it. Cases have been appealed and decisions rendered on such flimsy points as the placing, or misplacing of a comma, the wrong spelling of a word, or the omission of a date even where the context supplied all the necessary information.

"One naturally would think that after approximately 5000 years of formulating rules and regulations governing men in their relation to each other and designed in good faith to insure an even measure of justice for every individual, that every conceivable point had been covered and the administration of justice would be a comparatively simple process. Habits and customs, methods and processes of carrying on the world's work, barter and exchange between nations and individuals have been modified, simplified or expanded depending on contemporaneous circumstances; but human nature with its frivolities and weakness, pride and covetousness and above all the age old and deeply intrenched instinct of every man for himself, has remained the same throughout the centuries.

"Laws have been piled on top of laws. They have been extended, amended, expanded, interpreted, misinterpreted, dissected and analyzed. They have been written up, down, sideways, across, salute your partner and *chasse* down the center. They have acquired more knots than a ball of string I saw one time. It was 6 feet in diameter, representing 40 years' work on the part of an otherwise sensible man, who had devoted all his spare time to collecting every piece of string on which he could lay his hands.

"They have rolled up like a snowball traveling down hill on a muggy day in the early spring and yet if the tangle of verbiage was cut away and if the interpreters of the laws were more intent on the administration of justice, rather than on the splitting of hairs and quibbling over technicalities, they would find that the whole ponderous mass of legal jurisprudence could be boiled down to the ten simple commandments first inscribed on the tablets of stone on Mount Sinai. In fact they might go further and discover, probably to their astonishment, that the world could wag along nicely if the people only conformed to the greatest rule of conduct ever compressed into one sentence: Do unto others as ye would that others should do unto you."

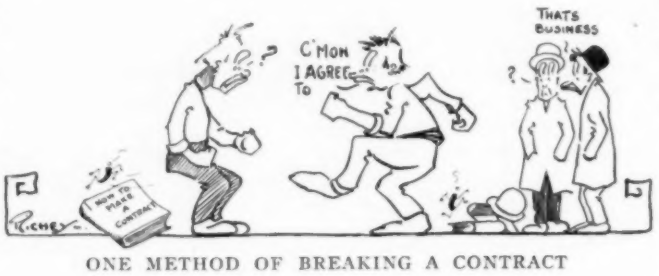
"That's all right," said Bill. "Some of it, anyway. I don't pretend to remember all you said, but I am willing to admit that the ball of string with its millions of knots is a happy illustration of that wonderful institution, somewhat vaguely referred to by the ordinary multitude, as the law. However, my dear Gaston, if you will permit me, I should like to direct your attention to a—shall I say glaring—fallacy in your concluding statement. I do not doubt the accuracy of your quotation or its historical authenticity; but you said: '*If* the people only conformed, etc.' That is the point where your whole ar-



A SECOND HAND FIRE SALE MIGHT SAVE HIM

gument falls down. Even the children have a saying: *'If,* is a crooked letter.'

"It is a notorious fact that people do not conform to the law and therefore some means must be adopted to straighten out, as far as possible, the everlasting tangles in which they are involved. You might say that when two ordinarily intelligent people enter into a simple contract, if each one does his part, no possible complications can arise. In the great majority of cases that probably is true; but frequently, chance, fate, luck, the finger of Providence—call it what you will—sees fit to throw a sprag in the wheel and then, notwithstanding the absolute honesty and probity on the part of the parties involved, a new deal all around is required to settle the fate of the pot." "I don't see the need or propriety of dragging poker terms into this discussion," I said. "If you want to talk about contracts, go ahead and talk about them; but if you intend to switch on to poker playing—and I think I recognize the symptoms—you can count me out. Tell the remainder of your story to Eddie."



ONE METHOD OF BREAKING A CONTRACT

"It must be a sore affliction," said Bill, "to be compelled to go through life hooked up to a one-track mind. Because I choose to employ a quotation or a term, from that standard authority Mr. Hoyle, it does not necessarily follow that I intended to describe a card game, any more than a reference to Spaulding's Guide could be taken as an indication that I intended to explain why the Yanks lost the pennant. I suppose to be strictly accurate I should say how the Yanks failed to win the pennant for, of course, a team cannot lose something which it did not possess.

"You can hang an argument on that point also if you are so inclined. Phrases are in common use and convey certain definite meanings to those who use them and to those who hear them and yet if you were to analyze them and lay them out according to the rules and regulations in due form provided for the purpose, you would not have a leg to stand on. When the lady of the house tells you to wipe your feet, you don't sit down, remove your shoes and stockings and then run your handkerchief over the high spots and among the toes of that part of your anatomy known among various strata of society as feet, trilbys, pedal extremities, hoppers and dogs. I should say not. You know that when she said feet, she meant shoes, and she knows that you know what she meant and you can quote every authority from the man who invented foot-pounds to the old woman who lived in a shoe and the net result will be 2-1 in her favor. Technically, you win, but like the majority of battles fought under similar circumstances, it does not mean anything.

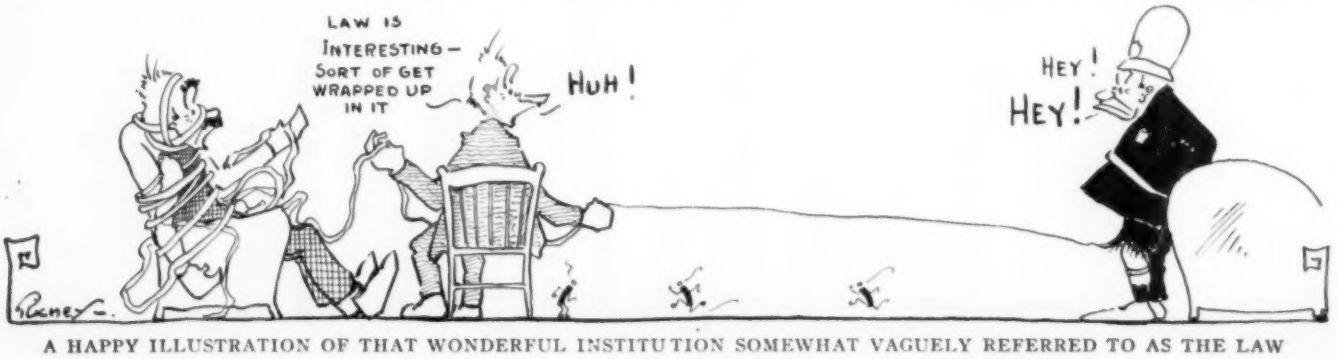
"I witnessed an incident while attending a show recently which illustrates the point in a still more striking manner. The hero was none other than that sterling and romantic young actor with the eyes that kind of toe in. You know the kind that afford the owner an opportunity of displaying his wit in such perfectly killing sub-titles as: 'Stand back ladies, I never shoot where I am looking!'

"At one stage of the proceeding the director instructed the man manipulating the lights to *throw the spot* on our hero during a particularly emotional bit in which the eyes were more than usually effective. I don't know how they affected others in the theater, but they brought up in my mind memories of a nursery rhyme that I had not heard since I was a child. Something about 'all around the mulberry bush the monkey chased the weasel.'

"However, apparently the man working the lights was literal minded and when the director told him to 'throw the spot' on old google-eye, he threw it. They throw lots of things around these movie studios which probably accounts for his excellent aim. The tin box landed on the actor's dome and flattened him out. He swayed a moment or two before he fell and registered the most blank amazement, first with one eye and then with the other. Even after he fell on the stage, the eyes remained open, one gazing about east-north-east and the other coyly trying to peep beyond the point of his nose." "A one-track mind may not meet with your approval," I said, "but it has one advantage and that is that its owner knows what he is talking about. When I start on a subject I like to finish it before I begin on another. You do not seem to care how or where you wander, or whether you take up one subject or a dozen. I am willing to bet you $4.00 now, cash money, that you have wandered so far away from the original subject that you don't know whether we were talking about the origin of species or original sin."

"I don't mind making a bet with a man," said Bill, "under certain circumstances; but I do object to highway robbery. Even at that I am half inclined to take away your money just to take some of the conceit out of you. We were not talking either of the origin of species or of original sin, although I will not go so far as to say that both do not exert a more or less direct influence on the subject we actually were discussing. Indeed if it was not for the fact that you seem to experience difficulty in following me I should like to touch briefly on both subjects. No, dear lad, do not waste your money making foolish bets. Save it and apply it to the purchase of a better receiving apparatus.

"You advanced the claim that mankind could get along nicely without the great bulk of laws that cumber our



A HAPPY ILLUSTRATION OF THAT WONDERFUL INSTITUTION SOMEWHAT VAGUELY REFERRED TO AS THE LAW

statute books. You even went further and expressed the opinion that if people only observed the Golden Rule no further laws of any kind would be required.

"While agreeing with you in the main that the law business is in drastic need of a general overhauling I attempted to point out that cases continually are arising which cannot be settled by an application of the Golden Rule. Sometimes on account of unforseen circumstances which introduce a factor or factors foreign to the original conception and sometimes owing to the fact that one or both parties never heard of the Golden Rule and would pay no attention to it if they did. You know some of these eye-for-an-eye and pound-of-flesh birds who base all their actions on 'the principle of the thing.' 'Tis true I introduced one or two examples to prove how easily misunderstandings arise over the spoken word and if you had not been in such a hurry I had intended to present a few examples of how the written word may be manipulated; but that is a long way from saying that I had lost the thread of my argument, or that I was side stepping the point at issue. Consider a hypothetical case covering a point with which all jobbing foundrymen are familiar.

"A customer orders a gear wheel for which you have to make a pattern. He only wants one casting and probably never will need a second. When the casting is shipped you render a bill which includes the cost of making the pattern and the customer pays it. The question then naturally arises: who owns the pattern? It looks simple enough and in the great majority of cases solves itself automatically. The pattern is of no earthly use to the customer after he receives his casting and usually he does not care whether the foundryman destroys it or places it in his pattern storage.

"You might say that since the customer pays for it that it should be delivered with the casting and, of course, sometimes that is done and all future complications avoided. You might claim with a fair degree of justice that the expense of making the pattern was only one of the factors involved in the general expense of making the casting. You may have had to rig up a special flask, provide a lifting plate and other items of that character, outside the general routine and yet if the customer suggested that he also was entitled to those things you would set him down as a lineal descendant of Captain Kidd or the James Boys, displaying the family characteristics in an enlarged and virulent form.

"Assuming for the moment that the customer says nothing about the pattern. He accepts the casting, pays his bill and the incident is closed. A second customer orders a gear wheel and when you look over your patterns you find that the pattern made for the first customer will fill the bill. Are you justified in using it? The first customer paid for the pattern and nominally owns it. If you use the pattern don't you think that the man who paid the first and full cost of the pattern is entitled to a rebate?

"Again, suppose your pattern storage burned down some dark night from cause or causes unknown outside the usual theory of crossed wires advanced by the fire department which fails to save any of the contents, but heroically prevents the fire from spreading to the other departments of the plant. You have carried insurance on the building and contents, paid your premiums as they fell due and now when the time comes to collect the value of your policy you probably have a battle on your hands to prove to the adjuster's satisfaction that you were not in some manner responsible for the fire. What would you think after you finally had received compensation if the man who paid for the pattern in the first place, were to present a claim for its value?

"You might advance the argument that you paid the premium on the insurance policy that covered the building and all the patterns contained therein; but that would not prevent him from coming back with a claim to the effect that the pattern he had paid for did not belong to you and therefore you had no right to insure it, or collect compensation for its loss.

"If the case came to a show down you probably could charge him for storage and the net result would be that one claim would cancel the other. In the meantime each of you would have paid fees and court costs that would aggregate forty times the value of the pattern.

"The Golden Rule is all right, but a written contract covering not only probable but improbable contingencies, is a wonderfully handy and convincing weapon in settling an argument.

"In accepting an order for castings, involving the supplying of patterns, there should be a distinct understanding regarding the ownership of those patterns after the order has been completed. If the foundryman owns them he should be free to use them as he sees fit. Use them in making castings for other customers. Store them or destroy them. Carry insurance on them or not, at his own option. Sell, lease or give them away.

"If the ownership of the patterns is vested in the customer he should take them away and store them in his own plant. If he leaves them with the foundryman, who according to universal custom stores them free of charge, then he should waive all claim to damage resulting from fire or other accident. If he wishes to carry insurance on the patterns, he, and not the foundryman, should pay the premium."

"I think," I said, "that you are making a mountain out of a mole hill. I never have heard of a law suit based on the ownership of a pattern."

"Well," said Bill, "neither have I; but there are many things I never have heard. Even if there never had been a case in the past that is no reason why there shouldn't be one in the future. I heard this question discussed some time ago at a meeting of men representing nearly 200 metal working plants and not one had a clear idea of his legal status. They were unanimously of opinion that the question was a live one and their secretary was instructed to secure a legal opinion. He was kind enough to send me a copy of the decision a few days ago and in fact that was what I had in mind when I started this argument. If you will be good enough to open your ears, shut your mouth and keep still, I'll read it to you.

"The letter was signed by a prominent firm of counselors at law and ran as follows:

" 'After looking up the law in a general way on this subject covering more than 30 states, it is our opinion that in case the patterns are destroyed by fire or otherwise, the foundry would not be liable provided they had exercised due care and diligence in the care of these patterns. In a lawsuit involving a question of this kind, it is a question for the jury to determine whether due care has been exercised except in cases where only one reasonable inference can be drawn from undisputed facts. Whether the appropriate degree of diligence has been exercised, must be determined by the jury from the circumstances in each particular case, such as the usage and custom of the trade, the nature and value of the thing in question and its liability to loss or injury.' "

"I don't know how that sounds to you," I said, "but it does not strike me as a definite ruling."

"Well," said Bill, "it is definite enough for me. It shows what a fat chance you would have to secure a decision, if you happened to get mixed up in a lawsuit, and placed all your dependence in the Golden Rule."

Making Nonferrous Castings

Details of Obstacles from a Metallurgical Standpoint That Have To Be Overcome To Produce Them Satisfactorily—Results from Test Bars Obtained Under Varying Conditions

BY GEORGE A. DRYSDALE

IN GENERAL foundry practice, so far as the metal is concerned, it is more difficult to produce nonferrous castings than it is to produce either gray or white-iron castings. The problem is to control the metal from day to day to comply with reasonable chemical and physical specifications. Nonferrous alloys are more susceptible to change while passing through the melting and casting stages and these changes are of major importance in governing the results obtained. Consequently the conditions which bring about these changes must be guarded closely.

In the melting of tin, copper, lead, antimony, zinc, nickel, etc., to form alloys, it is good practice to bring those having the higher melting points, into the molten state first, then adding the less refractory metals to the molten mass. When an alloy is formed from metals having different melting points, the resulting alloy arrives at the molten stage at a much lower temperature than the melting point of its most refractory constituent, consequently this is the most critical stage in the melting process. The temperature must be sufficiently high to insure complete alloying of the different metals and yet not reach a point that will result in excessive oxidation of those metals that melt at a comparatively low temperature. A suitable flux should be employed as a cover on all nonferrous metal while it is approaching and in the molten state, to protect it from the action of the air and gases.

Pouring temperature of nonferrous metal is of vital importance. The metal should be sufficiently fluid to flow easily and take a good impression of the mold. A high temperature will result in excessive occluded gases and a low temperature will cause segregation, especially where the metals employed to form the alloy show a wide variation in their chemical and physical properties.

Pouring temperature and the period of time elapsing before the metal sets in the mold control, to a great extent, the structure and physical properties of nonferrous as well as ferrous metals. The density of the metal and physical properties are in direct relation to the thickness of section as cast. This point also may be demonstrated by pouring any nonferrous alloy into green-sand, dry-sand, or chill molds. As a general rule, metal poured into molds containing dry-sand cores will show a more open structure than metal poured into green-sand molds. The finest grain structure is obtained where the metal is poured into a chill mold. The contraction, of course, varies with the density of the metal.

Under ordinary conditions, white iron poured into a green-sand mold will contract ¼-inch to the foot and will solidify without showing any crystallization. Gray iron under the same conditions will contract ⅛-inch to the foot and will present a varied crystalline structure, depending on its graphitic carbon content. Nonferrous alloys also contract approximately ¼-inch to the foot and show a crystalline structure.

On account of the high contraction and crystallization of nonferrous metals, and also on account of the fact that these alloys may be made up of from two to six elements in varying proportions and with each element differing widely from the others in the group, both in chemical and physical properties, it is apparent that the greatest problem with which the melter has to contend, is segregation.

In conducting tests on either new or old alloys, and to make these tests of practical value, the test pieces should be cast in the same manner and under the same conditions as the castings which they are presumed to represent. The dimensions of the test pieces should correspond with the thinnest and thickest sections of the casting. Attention of foundrymen sometimes is directed to remarkable statements in connection with tests taken from nonferrous alloys. Usually, when all the factors involved in the production of the test bars are revealed, the results obtained do not seem so remarkable. This point is illustrated in the accompanying table showing average results obtained from a number of test pieces poured in green-sand molds from an alloy composed of 50 per cent copper, 25 per cent nickel, and 25 per cent zinc, known as German silver. The pieces were machined down to the standard test bar diameter of 0.505-inch.

In the table shown, *A* represents test bars ⅞-inch diameter, 6 inches long, cast flat, two in a mold and provided with small risers according to ordinary foundry practice. *B* represents test bars ⅞-inch diameter, 12 inches long, poured on end, two in a mold and provided with heavy risers. These test bars were cut in two and the lower halves used for testing purposes. *C* represents test bars poured under pressure or, where the test pieces were cut from the lower part of a billet, poured on end. In this instance the billet weighed 40 pounds and the section cut from the lower end weighed 2 pounds before it was machined down to the required standard diameter of 0.505-inch.

Same Alloy Poured Under Varying Conditions

Marked	Diameter, inches	Yield point, pounds per square inch	Tensile strength, pounds per square inch	Elongation, per cent in 2 inches	Reduction in area, per cent
A	0.505	.....	30,000	nil	nil
B	0.505	.....	40,000	2.50	4.69
C	0.505	52,500	70,750	15.50	28.81

It may be noted that exceedingly high physical properties are indicated in the sample marked *C*, and yet the same metal poured under other conditions yielded test bars that in no way compare with the results shown in *C*. Conditions similar to the foregoing obtain in all nonferrous metals and therefore any report dealing with test bar results should include in-

formation covering the circumstances surrounding the pouring. Otherwise the report will be vague, probably misleading and in any case, of no practical value.

Extraordinary physical properties, at times, are claimed for certain alloys and such claims rarely have been substantiated where the metal has been tried out in actual castings in the foundry. The only satisfactory test bars are those which represent true working conditions under which the castings are produced. Wherever practical the test bar should be attached to the casting. The chemical and physical properties obtained from a test bar produced under these conditions will furnish a nearer approximation than a bar obtained in any other manner. Such a test bar is of practical value to the foundryman and a guarantee to the customer that the casting will meet his requirements.

How and Why in Brass Founding

By Charles Vickers

Coloring Brass Castings

Will you kindly advise us of a formula and method for dipping brass castings to bring out the color?

The castings first must be freed of all grease by soaking them in a hot solution of caustic soda, followed by washing in cold water. Then when dripped nearly dry, immerse them in the following solution:

DIP FOR BRASS

Yellow aquafortis (38%)	2 gallons
Sulphuric acid Sp. Gr. 1.19	1 gallon
Hydrochloric acid	2 ounces
Water	1 quart

Immerse the castings in the acid dip for a few seconds, remove and wash them in cold water, then immerse in a cyanide dip consisting of 2 to 4 ounces of cyanide of potassium in each gallon of water. After the cyanide dip, rewash, first in cold water, then in hot water and then dry in sawdust. Note that the cyanide of potassium must be handled with the greatest possible care as it is intensely poisonous.

Aluminum Plates Stained

We are sending for your inspection an aluminum step plate which is discolored and is rejected because of that. Can you advise what causes the dark color and how to avoid the same when using scrap metals. If we cannot avoid the coloration in casting, can it be removed?

Using scrap metals it is doubtful if the little oxidation stains can be avoided entirely in the foundry, therefore, it will be necessary to remove them if they are objectionable. It is a simple matter to remove the stains with nitric acid. Use acid as dilute as possible, adding the acid to the water, and first experiment with a solution of half water and half acid, which will whiten the castings. Put the dilute acid in a crock outside the building, or where there is a draft. The acid will whiten the castings immediately, and they should be dipped in acid, removed, rinsed in running cold water, then in hot water, and dried in sawdust.

Should any fumes come off from the acid, be particular the workmen do not breathe them. The castings being aluminum may dry without staining if the hot water bath is omitted, after a thorough washing in running cold water. This point quickly can be determined.

Alloy for Core Driers

We would like to obtain the formula for an aluminum alloy that we can use for core driers. We have tried straight No. 12 alloy but it does not appear to be hard enough.

The following alloy is harder than No. 12, and casts just as satisfactorily:

	Per cent
Aluminum	82.00
Copper	3.00
Zinc	15.00

While No. 12 containing 8 per cent copper will show a brinell number of from 50 to 55 the alloy just given will have a brinell number of from 60 to 65, and this will perhaps be what is required. If not, the hardness of the No. 12 metal can be increased by increasing the copper. Thus with 10 per cent copper it will be harder than with 8 per cent and the hardness can be increased further by raising the copper content to 12 or 14 per cent.

Coloring Cheap Alloys

We have an order for some metal to be colored. We use at present an alloy of tin, 9 per cent; antimony 19 per cent; lead, 72 per cent. What would you suggest to add to this mixture to color it, either one color, or several colors?

We know of no method that can be applied to produce any different color to the above alloy than it ordinarily shows. We believe that no matter what may be attempted that the color of the alloy will be inclined to a bluish white, a little lighter shade than that of lead.

However, a violet alloy can be made, but it has an entirely different composition to the above. It is copper 50 per cent; antimony, 50 per cent. The alloy is brittle, but is a deep violet and retains that color against all attempts to change it. Alloys of other colors can be made, but not from cheap, white metals. They are produced by alloying gold with percentages of silver, iron and other metals. A small percentage of nickel in gold whitens it, and cunningly contrived alloys of base metals are used to produce the well known *white gold*. An expert metallurgist can change gold into alloys of several colors, but in the case of the cheap, soft and fusible metals, the coloring has to be done on the surface of the object by electrode-deposition, or the use of pigments.

Bearing Metal Alloys

We would like your suggestions for a good marine motor bearing mixture. The man we have had for many years, mixing our metals satisfactorily has left us, and our new mixer is not so successful. We run our wrist pins on bearing metals bushings pressed into the pistons; our crank shafts on bushings pressed into the crank disk. Our motors range in size from 3 to 16 horse power and run at 500 to 650 revolutions per minute. Any suggestion will be highly appreciated.

If the mixtures used by the man who has quit were satisfactory, they easily can be obtained again by taking one of the bearings he made and submitting it to a chemist for analysis.

Either of the following alloys make excellent bearing metals.

BEARING METAL ALLOYS

		per cent
(1)	Copper	80.00
	Tin	10.00
	Lead	10.00
(2)	Copper	77.00
	Tin	8.00
	Lead	15.00

Melted Steel in the Cupola

Reminiscences of an Old Timer Touching Upon Experiences Connected with Some of the Earliest Recorded Attempts to Add Steel Scrap to the Ordinary Cupola Charge

BY ROBERT E. MASTERS

GRIZZLED old foundry veterans who may happen to see the name at the head of this article probably will stare pop-eyed while their minds will go back over 40 years and on memory's screen see that name and that of the late Thomas D. West, pioneer writers and authors of nearly all the articles on foundry practice appearing in the technical journals of that period. A little later, along in the eighties "when you and I were young, Maggie," the same name appeared occasionally backing up John A. Penton and his little red book. I extend hearty greetings to any of the old guard who have not yet passed to their mansions in the skies and without further preamble address a few words to present day foundrymen. So much has been written in recent years on the subject of producing semisteel castings I thought that a brief reference to my early personal experience along that line might be of interest.

I do not in any way claim to be the originator either of the idea or of the method of melting a considerable percentage of steel scrap with the regular iron charge in the cupola. I have no proof to offer, but I am of the opinion that steel scrap in limited amounts has been added to the cupola charge for 100 years, or possibly longer. However, indications pointing in that direction only came to my attention in later years and I knew or thought nothing of it when I began to melt steel in the cupola over 50 years ago.

If I cannot claim to be the first man to melt steel scrap as a component part of the charge in a cupola, at least I can lay claim to the distinction of being the first man to melt an entire heat of steel scrap without the admixture of any cast iron, either scrap or pig. The firm with which I was connected made thousands of steel plows every year and in a few years had accumulated an immense pile of plate steel scrap. We were so far from any market that the freight and labor of loading more than offset the value of the scrap at the nearest destination.

In the foundry we made castings for ice machines, cotton presses, railroads and for other purposes and I introduced enough steel scrap in the mixture to absorb all that was made in the plow fabricating shop each day. After some time I became ambitious to utilize the huge pile of steel scrap I had inherited and conceived the idea of running off a heat occasionally made up entirely of steel scrap. I fully realized that the resulting metal might not be suitable for all classes of castings, but we had a class of castings in which I felt that it would yield satisfactory service and we could make up a floor of this work now and then.

I had been publishing my experiences so long and so freely both in the technical press and through private correspondence that I now felt justified in asking for a little light on this particular problem. I doubted the feasibility of melting an all-steel charge in the cupola and decided to ask advice through the columns of the *American Machinist* and other technical journals. I explained fully what I intended to do and intimated that I should appreciate any information on the subject.

All this was in the early eighties when many foundrymen imagined that they were exclusive owners of some deep and important secrets and that it was necessary to be a member in good standing in the National Witches Union, Local No. 13, to secure certain results. If it was not regarded as a positive crime, it at least was considered a gross breach of confidence for an outsider to go upon the charging platform during the progress of a heat.

After waiting some time, in vain, I determined to put my faith to the test and the first heat was a decided success. Experience with the first heat suggested that the thin plate scrap would melt better if it was mixed with some coarser material. For the second all-steel heat I added a quantity of steel rails, cut in 1-foot lengths, to the thin plate scrap. This mixture melted satisfactorily; it was hot enough to run knitting needles and the bottom dropped clean at the close.

Henry Grady, editor of the *Atlanta Constitution,* was present in company with representatives from several other newspapers and as a result of that, my first newspaper interview, the news soon was flashed all over the country. I wrote an account of my experience and had it published in the *American Machinist,* and then discovered for the first time that hundreds of men had anticipated me. They claimed that they were familiar with the process and had practiced it for years. I sometimes had as many as 50 letters a day along this line and probably as many more were sent to the various technical journals.

It was all quite embarrassing for a time, until the late Thomas D. West in a signed statement in the *American Machinist,* showed how well he grasped the situation. This statement also indicated how far he was in advance of his times and I have pleasure in quoting it here:

The process of melting steel alone in an ordinary cupola, described by Robert E. Masters in the *American Machinist,* is, so far as I know or can ascertain, original with him. He kindly has sent me samples of the castings produced and, having examined them, I agree with the views set forth in his article that if the small castings were annealed they would be both tough and strong. The article has performed a valuable service in bringing this subject of steel melting in a cupola prominently before those who may be interested, and now that it has been started, interest in the subject will not be allowed to die out. One thing still remains to be done and that is to perfect a process by which castings may be produced direct from a cupola charged with steel scrap, castings that will be nearly as strong as the scrap before it is melted. The person who solves this problem will, I am sure, reap a rich harvest.

Among the friendly letters I received at the time the following is typical:

Cleveland, Ohio., U. S. A.
Iron Trade Review and *Western Machinist.*

Dear Mr. Masters:

You may be interested in knowing that our article on your famous melting process was copied by the *Iron Trade Exchange,* London, England, and also by the *Engineer and Iron Trade Advertiser,* Glasgow, Scotland.

Yours truly,
Day & Carter.

Mr. West's prediction was verified, the question was not allowed to die. Experiments were continued and for over 20 years foundries have been producing semisteel castings that are superior to ordinary gray-iron castings. The following facsimile of a newspaper advertisement published in the *Houston Post,* Houston, Tex., in 1908, indicates that the process was on a commercial basis at that time.

Semi-Steel Castings
From 1 pound to 20,000 pounds
"Talk about Tuff"
Houston Car Wheel & Machine Co.
Phone 956

Correcting Flaws in Metal Mixtures

Problems of the Gray Iron, Malleable and Steel Foundry Discussed

By H. E. Diller

Journal Boxes Made of Semisteel

Question: Please advise a semisteel mixture for journal-box castings. Would helical springs be a satisfactory grade of steel scrap?

Answer: A semisteel mixture for journal boxes should contain approximately 15 per cent steel, 40 per cent gray iron scrap and the remainder pig iron. The grade of pig iron you use will be determined largely by the exact amount and quality of gray iron scrap. The finished casting should contain 2.0 to 2.25 per cent silicon, less than 0.12 per cent sulphur, 0.3 to 0.6 per cent phosphorus and 0.6 to 0.9 per cent manganese. It would be preferable to have as much of the scrap as possible returned scrap from this mixture.

Helical springs, although not the best form of steel scrap, would be satisfactory to use if they are not made of too small wire and are not too bulky. Springs made of wire with a section less than ¼-inch in diameter would be apt to oxidize during melting. A heavy spring such as used in railroad car work would be more satisfactory.

Equip for Low Output of Malleable

Question: We operate a gray-iron foundry and have a demand for malleable castings from firms in which we are interested. Would it be practical for us to put in equipment for making about two tons of malleable iron castings a day? How much would the necessary furnaces cost?

Answer: It is usually considered unprofitable to operate a malleable foundry for making less than 15 tons of castings a day. However, special conditions sometimes allow a malleable foundry to operate successfully on less tonnage. The smallest air furnace which is considered practicable is one with a capacity of five tons of metal. To make your two tons of castings a day, only one heat would be required from such a furnace which would be more economically operated if two heats were taken off. A 5-ton furnace would cost you approximately $6000. You also would need one or more annealing furnaces, according to the rapidity with which you wish to get out castings. The annealing cycle is seven days; therefore if you had only one furnace which could easily take care of two tons of castings a day, you would have to wait seven days before you could make a second anneal. Therefore, some castings would require a wait of seven days before annealing and seven more days for annealing. An annealing furnace with a capacity of 12 to 15 tons of castings would cost you approximately $4000. These two items are the main items of expense for equipment. You would, of course, need squeezer machines for molding, annealing pots, etc.

If you have extra cupola capacity and would be satisfied with a somewhat weaker and less ductile iron; tensile strength 40,000 pounds per square inch and elongation 5 per cent in two inches, you could make iron with less cost by melting in a cupola.

Limit Steel in Mixture

Question: I would like to make semisteel with as high a percentage of steel as is possible. Will you kindly advise me how much steel can be used in a cupola charge, and what the composition of the semisteel should be?

Answer: You do not give a clear indication of the size of castings which you are to make, or what properties you desire in the semisteel. The size of the castings would govern, to an extent, the composition which is needed in the semisteel. In the ordinary grade of work you would want to get a semisteel with approximately 2.0 per cent silicon. The sulphur should be kept below 0.12 per cent by the use of low-sulphur coke; the phosphorus should range between 0.3 and 0.6 per cent and the manganese should be kept near 0.8 per cent. The desired amount of manganese can be obtained by the use of high-manganese pig iron, or by adding a little spiegeleisen in the cupola. Phosphorus will come from the cupola in about the same percentage as that carried in the metal charged.

As high as 50 per cent steel is being used in semisteel mixtures in the cupola, but it is extremely difficult to get this metal uniform. Probably you could secure the results you desire and have a more uniform metal by using 25 to 30 per cent steel in the mixture. The remainder of the mixture should be about half scrap and half pig iron.

In calculating your mixture you must remember that steel contains no silicon and therefore silicon must be secured from the pig iron and scrap, or by the addition of ferrosilicon. The following will give you an example of this: Where 25 per cent of the charge consists of steel without any silicon, 35 per cent of gray-iron scrap with 2 per cent silicon, and 40 per cent pig iron with 3 per cent silicon, the amount of ferrosilicon to be added in computed in the following manner.

Steel scrap	25 x 00 =	00.00
Gray-iron scrap	35 x 2.00 =	70.00
Pig iron	40 x 3.00 =	120.00
	100	190.00
Ferrosilicon	3.5 x 10.00 =	35.00
	103.5	225.00

Thus for the original charge you would get 1.90 per cent silicon. With a loss of 0.25 per cent silicon in the cupola, the iron would be too low in this element. If you do not have any pig iron with higher silicon you would have to add ferrosilicon. The example is calculated with the addition of 10 per cent ferrosilicon amounting to 3.5 per cent of the charge. This would give a total of 225 points silicon, which, divided by 103.5, the percentage of charge used, would give an iron with 2.17 per cent silicon. A loss of 0.25 per cent in melting would leave an iron with 1.92 per cent silicon.

Hard To Chill Iron

Question—We want to make a hard chilled point on a cam casting of gray iron. The cam is 3½ inches thick and 3½ x 5¾ on the side surface which is wide at the middle and tapered to a rounded point at each end. We have tried pouring the metal against cast-iron chillers but it did not become as hard as we would like it.

Answer—The only method of hardening the points on the cam casting of which you write, is to chill the iron. If the iron does not become entirely white at these points, it is due to not having a large enough chiller or having too much silicon in the iron.

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Pyrometer Aids in Making Castings

NOT many years ago with the first application of chemistry to the foundry industry, the idea became prevalent that it was necessary only to secure the proper metal composition and to pour it so that no slag entered the mold to secure satisfactory castings. However, it is becoming more generally realized that many other variable factors enter into the production of satisfactory castings. One of these is maintaining the correct temperature in pouring and annealing, and in some cases, even in melting. Before the advent of the pyrometer, it was almost impossible to determine melting and pouring temperatures, and even with the use of seger cones it was difficult to control annealing temperatures. Now that many different types of pyrometers have been provided for determining the degree of heat accurately, under almost any condition, interest in this question has been greatly increased among foundrymen. In the nonferrous field, the pyrometer has proved valuable especially in melting and pouring aluminum. It has been found that the metal must not be heated beyond a certain point in melting and must be poured as cold as possible. By placing a pyrometer in the molten bath it is possible to determine whether the metal is hot enough to be poured into the ladle. Then, in many shops, the temperature of the metal in the ladle again is determined before it is poured into the mold. Other nonferrous alloys have not been as carefully watched for melting and pouring temperatures, but for some of these metals the pyrometer has been found extremely useful.

In the malleable castings industry the recording pyrometer has established its usefulness without question and now few, if any, annealers attempt to malleableize iron without the use, either of the recording or indicating instrument. Of course, if the melter is to be implicitly trusted an anneal can be made about as well with the aid of an indicating as with a recording pyrometer. However, a recording pyrometer not only serves as a check on the annealer, but if both instruments are used, the one checks the accuracy of the other.

The pyrometer also is used to a considerable extent in annealing steel castings, where it has been shown that a difference of 100 degrees above or below the correct temperature means a marked reduction in the physical properties. Until quite recently practically no use was made of the pyrometer in determining the temperature of molten iron or steel. This was not because the temperature of the molten metal was not thought to be important, but because of lack of suitable means for determining the temperature. However, the optical pyrometer has been so well developed recently that a number of iron and steel foundries use it regularly to determine the pouring temperature of the metal, and others use it for research purposes. As has been noted, the temperature of the lower melting point alloys may be determined by introducing the thermocouple of the pyrometer directly into the metal and it is not necessary to use the optical pyrometer.

One of the hindrances which has prevented the more general use of the pyrometer in the foundry has been the neglect and careless handling of the instrument. This throws it out of calibration and causes it to give incorrect readings. This difficulty has been overcome to a marked extent by building a more rugged instrument and by impressing the men who handle it more thoroughly with the necessity for reasonable care.

Trade Outlook in the Foundry Industry

RESTRAINED optimism correctly describes the attitude of the foundry industry at the close of 1922. Practically all lines of castings manufacture are on a sound basis, with orders on their books, with an ample volume of inquiry to support the expectations for prosperity in the first of the year and with inventories reduced to a reasonable status. The flurried activity of the post-war period, and the deep pessimism, the feeling of helpless futility which marked the low point of the past business depression alike are absent. Construction of new plants and additions to existing establishments testify to the industry's faith in the future.

Stocks Are Low

Foundry operations throughout the year have not warranted the accumulation of large stocks of iron or fuel. Although the melt has increased steadily, buying in advance has been indulged in with caution and as a result the majority of shops come to the close of the year with depleted storage yards. However, buying has started and contracts by the larger interests such as pipe plants, sanitary ware and the large electrical machinery manufacturers have been sought extending through even the second quarter of 1923. Prices have been weak, as the accompanying table shows. The November output of pig iron according to statistics compiled by the *Iron Trade Review* continued the upward trend of the past several months. The total production for the month past was 2,845,595 tons as compared with 2,629,655 tons for October. This gives an increase of approximately 216,000 tons, or on a daily average basis, a gain of 10,026 tons per day, the October figure being 84,827 tons and the November, 94,853 tons. November's output of merchant iron was 602,884 tons, an increase of 3895 tons per day over the previous month.

Prices of Raw Material for Foundry Use

CORRECTED TO DEC. 7

Iron		Scrap	
No. 2 Foundry, Valley	$28.00	Heavy melting steel, Valley	$20.50 to 21.00
No. 2 Southern, Birmingham	22.00 to 23.00	Heavy melting steel, Pitts	20.00 to 20.50
No. 2 Foundry, Chicago	28.00	Heavy melting steel, Chicago	16.75 to 17.25
No. 2 Foundry, Philadelphia	27.76 to 28.13	Stove plate, Chicago	18.00 to 18.50
No. 2 Foundry, Buffalo	25.00 to 25.50	No. 1 machy. cast, Chicago	22.00 to 22.50
Basic, Valley	25.50	No. 1 cast, Philadelphia	20.00 to 21.00
Basic, Buffalo	26.00	No. 1 cast, Birmingham	17.50 to 18.00
Malleable, Chicago	28.00	No. 1 cast, Buffalo	21.00 to 22.00
Malleable, Buffalo	25.50 to 26.00	Car wheels, iron, Pittsburgh	21.00 to 22.00
Coke		Car wheels, iron, Chicago	23.50 to 24.00
Connellsville foundry, coke	$7.00 to 8.00	Railroad malleable, Chicago	22.50 to 23.00
Wise county foundry, coke	8.50 to 9.00	Agricultural mal., Chicago	22.50 to 23.00
		Malleable, Buffalo	20.00 to 21.00

Auto Industry Sound

The phenomenal strength in the market for automotive castings continued into December and that foundry operations in cylinder shops were lighter during the present month is due only to the desire of automobile manufacturers to carry over a light inventory. Orders for the first of the year already have been placed in sufficient volume to indicate much business during the late winter and early spring. This assumption is supported by the heavy bookings of steel for automobile manufacture. New building construction also has held up well into the winter. Building permits secured during October established a new high record for that month, while evidence is offered that the building boom may be expected to continue into the spring. The effect upon foundry operations has been marked. Stove and furnace makers are working to capacity, while the demand for sanitary ware, soil pipe and building hardware has been exceptionally heavy. Cast iron pipe demand is good, considering the season. A recent sale of 20,000 tons for San Juan, Porto Rico, has been made by the United States Cast Iron Pipe and Foundry Co.

Rail Buying Grows

Additional freight car awards during the first week of December totaled 9300, making the sum for the two weeks approximately 20,000 cars, while the Chicago district deports 35,000 additional cars under active negotiation. In the East, approximately 6000 cars are up for bids, and locomotive orders continue in proportion. Car wheel foundries, and those making miscellaneous castings for railway service are operating practically to capacity. This has had a marked effect upon the sales of malleable castings. At present malleable foundry operations are maintained at about 65 per cent of capacity or over 80 per cent of what might be considered normal. Railway shipments are improved, and the freight car shortage has dropped to 152,565, compared to a shortage of 158,236 for the early part of November. Machine tool foundries are beginning to experience better prospects.

Nonferrous Improved

Brass and aluminum foundries are sharing in the general advance. Demand for plumbing brass goods is fair and with the present state of dealers' stocks, may be expected to pick up throughout the winter. Jobbing foundries, particularly those catering to the rolling mill industry are active; while the demand for brass and aluminum castings from the automobile industry is expected to be heavy after the first of the year. Nonferrous foundries forming departments of manufacturing establishments are operating at about 80 per cent of capacity. Prices of nonferrous metals based on New York quotations in the *Daily Metal Trade* of Dec. 7, follow: Casting copper, 13.40c to 13.50c; electrolytic copper, 13.87½c; Straits tin, 37.25c; lead, 7.25c to 7.35c; antimony, 6.40c; aluminum, No. 12 alloy, producers' price, 24.00c to 24.20c and open market, 20.50c to 21.50c. Zinc is 7.35c, E. St. Louis, Ill. The average prices on nonferrous metals for November follow:

(New York Quotations)

Casting Copper	Electro Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
13.42	13.846	7.176	36.712	6.545	21.375	7.151

Comings and Goings of Foundrymen

SAMUEL D. SLEETH, general superintendent of the foundries of the Westinghouse Air Brake Co., Wilmerding, Pa., retired on Dec. 5, his seventieth birthday, after an unusually active foundry career of nearly 60 years. Mr. Sleeth began his foundry work in 1865, at the age of 13, in the foundry of Lewis, Ormsby & Phillips, of the Southside, Pittsburgh. Five years later he went with the Westinghouse Air Brake Co., to work as molder under his father who was then the foundry foreman. Mr. Sleeth worked at the bench at the Air Brake foundry until 1887 when he was made assistant to his father. When the plant was moved from the center of Pittsburgh to a larger site in Wilmerding, Mr. Sleeth was made foreman, his father having died shortly before the removal. A few years later he was given the title of superintendent, and in 1916 when the Union Switch & Signal Co. was taken over by the Westinghouse Air Brake Co., and the foundries merged, he was appointed general superintendent, from which position he has retired. On March, 1920, the employes of the foundries presented Mr. Sleeth with tokens in celebration of his fiftieth anniversary with the Westinghouse company. Mr. Sleeth, through his long career, has given thoughtful attention to modern foundry methods. He originated the continuous molding process which he installed a number of years ago in the foundries of which he was superintendent. He has also been active in the affairs of the American Foundrymen's association and the Pittsburgh Foundrymen's association, having served as vice president of the former and president of the latter.

F. L. Overstreet has been appointed a Foundry instructor in the University of Nebraska, Lincoln, Neb.

William Lewis Todd recently left the Davis & Furber Machine Co., North Andover, Mass., to take charge of the melting department of the Saco-Lowell Shops, Lowell, Mass.

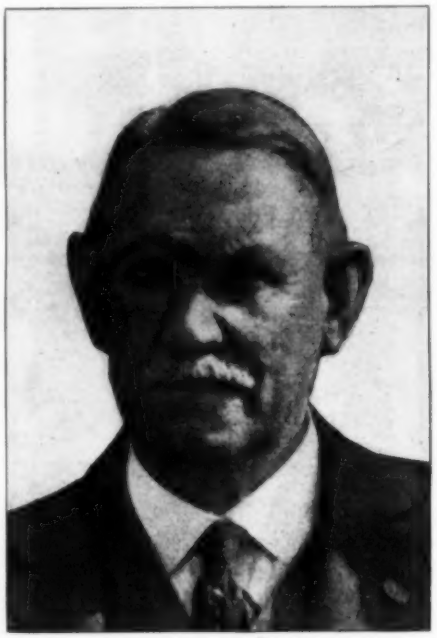
Jean Carles, engineering delegate of the Association Technique de Fonderie de France, has resigned that position to become manager of a foundry at Amiens, France.

A. A. Heller has taken over the management of the International Oxygen Co., Newark, N. J., in place of L. W. Hench, secretary and general manager, resigned.

J. A. Le Bold, formerly handling production for the Home Stove Co., Chicago, Ill., is now superintendent of the Des Plaines Foundry Co., Des Plaines, Ill., a thirty-molder light jobbing shop.

Albert Jaeck, core room foreman of the Farrell-Cheek Steel Foundry Co., Sandusky, O., will leave to take charge of the core rooms at the Blackwood Electric Steel Corp., Parkersburg, W. Va.

A. E. Jones, sales engineer in the New York office of the Terry Steam



SAMUEL D. SLEETH

Turbine Co., has accepted a position with W. B. Connor, Inc., 90 West St., New York, in a similar capacity. Mr. Jones will assume his new duties January 1.

Everett D. Betts, recently having disposed of his interests in the Production Foundries, Ann Arbor, Mich., is now connected with the foundry department of the Ford Motor Car Co., River Rouge plant, Detroit, Mich.

C. T. Wilson has been appointed superintendent, American Skein & Foundry Co., Racine, Wis., maker of wagon skeins and piano plates. John Hyde, formerly superintendent, has been placed in charge of sales.

Harry J. Reefe, formerly manager of the order department of Independent Pneumatic Tool Co., 600 W. Jackson boulevard, Chicago, has been appointed to the position of purchasing agent, succeeding Thomas J. Keegan, resigned.

Edgar M. Lewis has resigned from the J. S. McCormick Co., Pittsburgh, Pa., to become associated with the Blackwood Electric Steel Corporation of Parkersburg, W. Va. Mr. Lewis is well known in the foundry and allied industries. He has long been identified with the Foundry Supply line, formerly holding important offices with the Hill & Griffith Co., Cincinnati, and the E. J. Woodison Co., Detroit. He will join the Blackwood Electric Steel Corp. Jan. 1, 1923.

Alexander Blackwood has resigned as general manager of the Farrell-Cheek Steel Foundry Co., Sandusky, O., effective January 1, 1923 or sooner if a successor is obtained. Mr. Blackwood has been elected president and general manager of the Blackwood Electric Steel Corp., Parkersburg, W. Va. The Blackwood Electric Steel Corporation has now under construction a large modern foundry capable of producing 300 tons per month of high grade electric furnace steel castings and alloy steels. The Blackwood Electric Steel Corp. will be in production by March, 1923.

B. D. Thomas, general manager of sales for the Acme Steel Co., Glassmere, Pa., has tendered his resignation to become effective Feb. 1, 1923, as he has been made vice-president and sales manager of the Blackwood Electric Steel Corp., Parkersburg, W. Va. Mr. Thomas is a practical Steel Foundry man and has been affiliated with the iron and steel industry since early boyhood. He entered the employ of the American Car & Foundry Co., St. Louis, Mo., at the age of 14, working successively in the foundry, shops, mechanical and sales departments until the outbreak of the war. He then enlisted and as 1st Lieutenant was assigned to the ordnance department and put in charge of the Pittsburgh district inspection division of shell manufacture, later being made captain. At the expiration of the war he became connected with the company he is now leaving.

To Hold Christmas Party

A Christmas party to be given by the Pittsburgh Foundrymen's association Dec. 18, was announced at the regular monthly meeting and dinner of the organization held in the General Forbes hotel, Nov. 22. E. J. McConnell, sales manager of the open-hearth combustion division of

the Blaw-Knox Co., Pittsburgh and Blawnox, Pa., described the new open hearth combustion system just being introduced in Pittsburgh plants, at the November meeting. Improvements in open hearth furnace operation were outlined, with particular regard to port construction as embodied in McKune and Egler furnaces.

Dates for International Conference Set

Dates for the international foundrymen's conference and exhibition which will be held in Paris next year under the auspices of the Association Technique de Fonderie de France have been selected. The exhibition of foundry supplies and equipment, which will be held at the Ecole d'arts et Metiers, will open on Thursday, Sept. 6, 1923 and close two weeks later, Thursday, Sept. 20. The international congress of foundrymen will open Wednesday, Sept. 12 and continue until Saturday, Sept. 15. Elaborate plans are being made and it is expected foundrymen's organizations from all over the world will co-operate.

The British Iron and Steel institute will hold its autumn meeting in Italy early in September 1923 and the dates of the foundrymen's congress and exhibition have been arranged so that members and others attending the Italian meeting may also attend the congress in Paris.

Acquires a Large Plant

Eastern Steel Castings, Avenue L and Edward street, Newark, N. J., is being organized to take over early next year the business of the Bayonne Steel Castings Co., Bayonne, N. J. The new company is headed by William D. Sargent, now president of the Bayonne Steel Castings Co. The company will have a much larger plant, equipped for making both open-hearth and electric steel castings.

Opens National Offices in New York

The Chemical Equipment association, comprising manufacturers of equipment essential to manufacture in the score or more of chemically controlled industries of the continent, has established national executive offices at 1328 Broadway, New York.

This association was organized September 12, 1922, following preliminary activities of an organization committee of representatives of leading manufacturers.

The officers of the Association are: President, Pierce D. Schenck, president, the Duriron Co. Inc., Dayton, O.; vice presidents, J. George Lehman, vice president and general manager, Bethlehem Foundry & Machine Co., Bethlehem, Pa.; Walter E. Lummus, president, the Walter E. Lummus Co., Boston; and Adolph Coors, Jr., vice president, Coors Porcelain Co., Golden, Colorado; treasurer, Percy C. Kingsbury, chief engineer, General Ceramics Co., 50 Church St., New York; secretary, Roberts Everett.

The directors are H. N. Spicer, the Dorr Co., New York; P. S. Barnes, the Pfaudler Co., New York; Edwin C. Alford, T. Shriver & Co., Harrison, N. J.; T. C. Oliver, treasurer-general manager, Chemical Construction Co., New York; Hamilton Allport, E. B. Badger & Sons Co., New York.

The association has already established communication with nearly 200 of the large industrial associations of the country announcing itself as a source of information in chemical equipment supply matters, and has begun a regular bulletin service to members. Further, it is arranging details of a permanent cooperation with the United States department of commerce in the collection and dissemination of vital trade information.

Reduced Railroad Fares for Foundrymen

The passenger associations have granted the petition of the American Foundrymen's association for reduced rates on the identification plan, to the next foundrymen's convention to be held in Cleveland from Monday, April 30 to Thursday, May 3, inclusive. The reduced rates will also apply to cover Saturday, April 28, when the exhibit of foundry equipment will open.

This is the same plan used at Rochester last June and assures the round trip rate of one and one-half the regular one way fare to all persons who present, at their home railroad station, an identification certificate issued by the secretary of the association.

Not only will this ruling of the railroads result in a saving of many thousands of dollars to the members of the Association, but it will do much to encourage a large attendance.

Book Review

Tales From the Gangway, by Pat Dwyer engineering editor THE FOUNDRY; cloth; 450 pages 6 x 9 inches with frontispiece and over 200 illustrations; published by the Penton Publishing Co., Cleveland and furnished by THE FOUNDRY for $3.00.

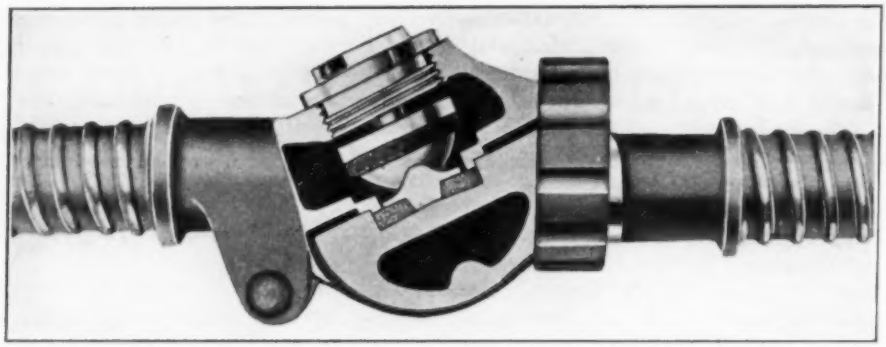
Something distinctly unique in the way of technical literature is presented in this work compiled from articles that have appeared in THE FOUNDRY over a period of several years. Bill, the typical foundry foreman who followed the hobo trail in the days of his lusty youth recalls in an interesting manner, events and incidents in a variegated career that embraced brief sojourns in foundries scattered from Canada to Old Mexico and from the Atlantic seaboard to the Coast.

Shrewd observation and kindly humor characterize his references to people and events connected at times with the foundry industry and, at other times, not even remotely related. Some of the best chapters deal in a highly entertaining, burlesque manner with popular misconceptions prevalent among those benighted human beings who have not been blessed with a foundry upbringing. The highly scientific method by which cast iron pots are blown by compressed air should prove a revelation to men engaged in the art and the measure advocated for pounding iron with a drop ball to make it soft furnishes a valuable hint to those whose castings always are too hard. In two particularly delightful chapters, Bill impales his favorite enemy the foundry expert on the end of a delicately poisoned lance.

However, Bill's absorbing interest in the foundry is evidenced by the fact that irrespective of whether he prefaces his remarks by a discussion of the proper way to raise children, the merits of tobacco, the influence of the great national game, or, the manner in which pigs infected with the hay fever germ behave in the cupola, he always concludes by a description of the methods employed to solve some specific foundry problem.

For the benefit of those who may not have read the articles as they appeared originally it may be stated that the purpose of the book is serious. Each chapter deals in an authorative manner with some specific phase of modern foundry practice and therefore reflects the latest and most modern development in the industry. The series of articles on pattern mounting methods is the most complete and illuminating that ever has been published. The same applies to the various chapters dealing with cupola operation, gear and sheave molding, coremaking and preparation of sand.

The language used is informal and as far as possible non-technical and in that respect the book should serve as a valuable text book on American foundry practice not only to students but also to those of extended experience in the profession. The text has been kept free from reference to the purely obvious, or what may be regarded as ordinary routine practice and deals only with prominent and outstanding features, a knowledge of which is required by the man who desires a comprehensive and



AN AIR HOSE COUPLING WHICH HAS AN AUTOMATIC CHECK VALVE

rounded out acquaintance with every branch of the business including modern core making, molding and cupola practice. Not the least interesting feature of the book is the profusion of line drawings and cartoons that enliven the pages.

Designs Automatic Valve for Hose Couplings

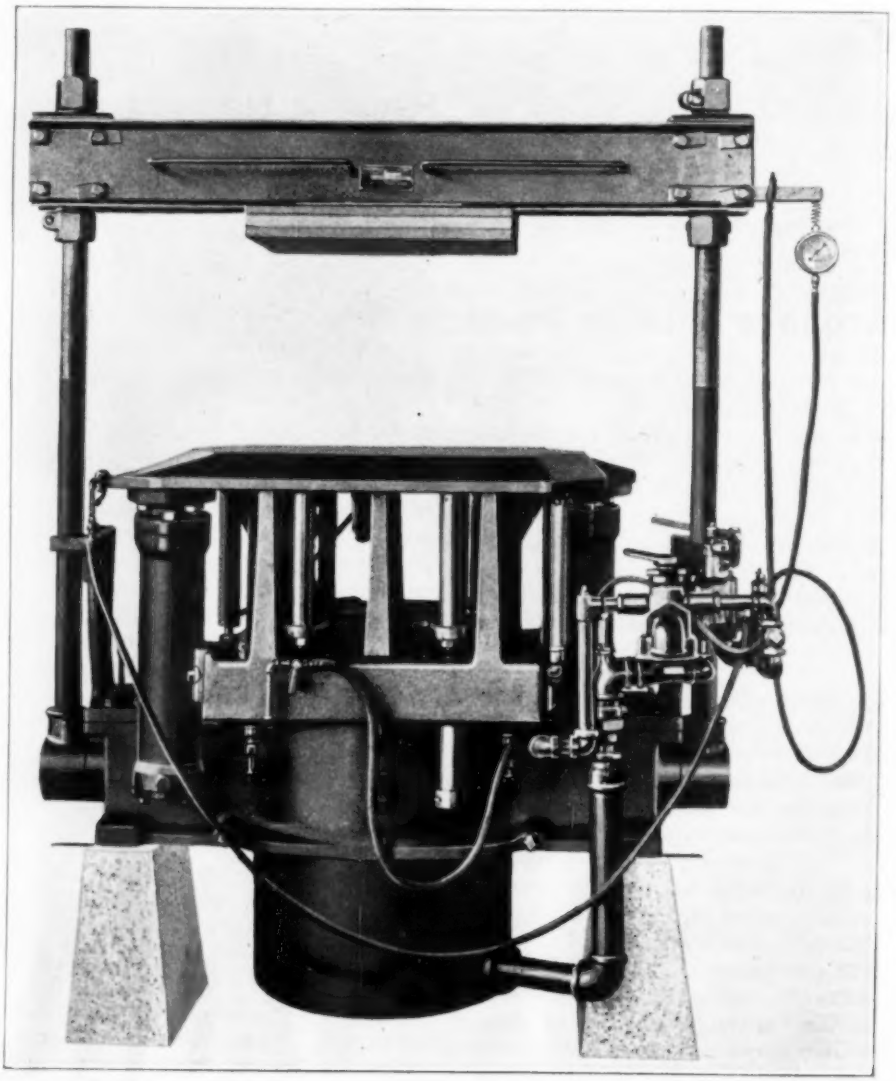
An automatic air house coupling to be used on compressed air lines, has been recently introduced by the Robinson Machine Co., Muskegon, Mich. The accompanying illustration shows a cross sectional view of the coupling in a position ready for use. The appliance is a combined valve and coupling made in two halves. The half containing the automatic check valve is so constructed that the pressure of the air in the line comes on the top of the valve insuring a constant valve action. The valve proper consists of a brass stem with a renewable leather disk valve facing, which is easily replaced without special tools. Two projections with a crossbar extending beyond the valve seat act as a protection for the valve when it is dragged along the floor. This crossbar forms a pivot for hooking on the hose end shank when making the connection.

The hose shank half has two small projections beyond the valve face to push open the valve when the connection is being made and thus admit the pressure to that section of the line. An eccentric clamping ring quickly locks the two halves of the coupling together. This device is claimed to save the time of the operator and also the volume of air in the line between the compressor and the point of cut off.

Completes Order Several Large Machines

Several large jolt-squeeze, split-pattern, molding machines of the Mumford type, shown in the accompanying illustration, recently have been completed by the Hanna Engineering Works, 1765 Elston Ave., Chicago. The squeeze cylinder has a diameter of 21 inches, the table will accommodate a flask 24 x 24 inches, the machine has a pattern draw of 12 inches and measures 56 inches between the strain rods. The ramming head construction is the same as on smaller units. Pattern drawing is accomplished by two automatic, slow-start, oil-pattern, draft cylinders controlled by a knee valve. After the mold is removed, the flask table settles to its original position. The pattern-draft, guide plungers are fitted with leather hat packings held in place by standard glands. The same pressure that drives the draw plungers up squeezes the packing around the plunger. When pressure is released from beneath the plungers, the packing also is released and allows the flask frame to settle without resistance.

Jolting is accomplished by the patented valve inserted through the side of the cylinder into a pocket longitudinal with the axis of the plunger. Both side walls of the pocket are provided with parallel machined strips. The inside jolt valve is cylindrical except near the inside where two flats have been milled on opposite sides thus forming a cubical plug which fits between the flats in the plunger pocket. The inside jolt valve supported rigidly in the cylinder provides an inside guide for the jolt-squeeze feature the surfaces of which practically are at right angles to any twisting motion of the plungers. The surfaces are protected and adequately lubricated. The plunger is provided with cast-iron piston rings and the squeeze valve is of the air brake type.



COMBINATION JOLT AND SQUEEZE MACHINE HAS A 12-INCH PATTERN DRAW AND TABLE CAPACITY FOR A FLASK 24 X 24 INCHES

Equipment Inquiry Is Brisk

Year End Inquiry Indicates Bright Prospect for January Business—New Undertakings, Replacements and Additions Again Feature the Market for Machinery

EARLY December purchases of foundry machinery and supplies have been surprisingly heavy in view of the general effort to reduce inventories at the first of the year. Coupled with extensive sales has been a brisk inquiry which promises a large volume of business for equipment manufacturing early in 1923. Interest in electric melting units is accelerated. Recently the Pittsburgh Electric Furnace Co., Pittsburgh, has sold a 3-ton unit to the Bonney Floyd Steel Foundry Co., Columbus and one of similar capacity to the Dayton Steel Foundry Co., Dayton, O. The Detroit Electric Furnace Co., Detroit is installing 3 melting units at the plant of the Neptune Meter Co., Long Island City, N. Y., a 2000-pound furnace at the Tottenville Copper Co., Staten Island, and a 500-pound vessel at the United States Arsenal, Watertown, Mass. Further, the same interest has sold a 2000-pound, 300 kilovolt ampere brass melting furnace to the Ford Motor Co., Detroit, completing a battery of eight units at the brass foundry of that interest. The Ford company recently has been a heavy buyer of molding machines, 12 machines being placed with the Berkshire Mfg. Co., Cleveland, in addition to others mentioned elsewhere in this article. Recent sales of sand-blast equipment by the Pangborn Corp., Hagerstown, Md., include machines for the Commonwealth Brass Corp., Detroit; Sullivan Machinery Co., Claremont, N. H.; National Supply Co., Toledo, O.; and the Cresson Morris Co., Philadelphia. The same company recently has shipped a number of small gun type sand-blast sets to South America and Australia. The Berkshire Mfg. Co., Cleveland, has an order for a molding machine from Charles Judd, Thames, New Zealand. The Rabe Pipe & Foundry Co., Chattanooga, Tenn., is increasing the capacity of its sewer pipe works.

Improvement Noted in the East

DEMAND for foundry equipment continues rather spotty, but, nevertheless, is somewhat improved as compared with two weeks ago. Sand cutters and sand blast equipment is in better demand than at any time since the early part of October, and several sizable sales of flasks have been reported within the past few days. While several purchases are for fitting out new plants and additions, the great bulk of orders is for replacement purposes. A recent sizable buyer of foundry equipment is the Pennsylvania railroad which has made some purchases presumably for its Altoona, Pa., shops. Other buyers are the Colvin Foundry Co., Providence, R. I., which has closed on a tumbling barrel to the Whiting Corp., Harvey, Ill., and the Fisher-Sweeney Bronze Co., Boundbrook, N. J., which is installing a 180-foot crane runway and a monorail hoist, to be built by the Cleveland Crane & Engineering Co., Wickliffe, O. While the Boundbrook foundry of the Fisher-Sweeney company is just being established, a complete new outfit will not be required. The company it is said, was able to salvage some equipment from its Hoboken plant which was badly damaged by fire several weeks ago, and also is installing equipment from its plant in Newark, which it is now being merged with the new plant. The Bartlett Hayward Co. recently reported as placing several cranes for its new foundry in Baltimore, bought this equipment from the Chesapeake Iron Works, Baltimore. The cupolas, tumbling barrels, ovens, ladles and other equipment, went to the Whiting Corp., Harvey, Ill. Among likely buyers in the near future are the Connecticut Brass Co., Waterbury, which is having plans prepared for a new foundry, the Fuller-Lehigh Co., Fullerton, Pa., which is contemplating the erection of a new foundry to replace the one recently badly damaged by fire and the Chicago Nipple Mfg. Co., which is building a 1-story addition to its branch plant in Baltimore. The American Welding Co., Carbondale, Pa., contemplates a new brass and iron foundry in the New York Metropolitan district, but will probably not begin operations much before next spring. It is likely also that the New England Steel Castings Co., Springfield, Mass., will start work on a foundry about that time to replace one damaged by fire. The Cohler Mfg. Co., Philadelphia, maker of sanitary ware, will start work shortly on a new plant, and also the Prentiss-Wavers Stove Co., Wisconsin Rapids, Wis. In this latter case, it is understood a complete new foundry will be erected.

Pittsburgh Buying Deferred

MANY foundries in the Pittsburgh territory, expected to buy foundry equipment, are postponing action until after the holidays and the inventory season. A large number of inquiries are current for equipment of various kinds, including sand conveying, mixing and cutting units; molding machines, one or two cupolas, core ovens, together with a fairly large number of tumbling barrels, ladles, wheelbarrows, shovels, riddles, etc. The Duquesne Steel Foundry Co., Coraopolis, Pa., and the Velte Foundry & Machine Co., Mars, Pa., both of which suffered losses from fire recently, are understood to be contemplating the purchase of pattern shop and other foundry equipment, negotiations being held up until after insurance adjustments have been completed. The Duquesne company, however, closed on a 10-ton, 3-motor crane with 50-foot span, the award going to the Pittsburgh Crane & Equipment Co., Pittsburgh, which also sold the Duquesne Light Co. a 5-ton crane. The latter interest also bought 16 transformer trucks. The Monessen Foundry & Machine Co., Monessen, Pa., is doing some rebuilding and may purchase additional foundry equipment. The A. M. Byers Co., South Side, Pittsburgh, recently closed on a small cupola, tumbling barrel and other equipment for a small foundry which it is building for its own purpose. Many molding machine propositions still are held in abeyance. On a number of these verbal orders have been placed, but the confirming documents have not been forthcoming. These are expected to develop before the month is out. One or two nearby foundry interests have closed on a single molding machine each. Action likewise has been postponed on several crane and hoist inquiries which have been before the trade for some time. The Westinghouse Electric & Mfg. Co. entered the market last week for a 5-ton crane for its Homewood plant, Pittsburgh, but the Cutler Steel Co. has withdrawn its crane inquiry involving

a unit of similar size. The Universal Steel Co., Bridgeville, Pa., still is negotiating for a 7½-ton crane. The United States Radiator Corp., Detroit, has bought a 78-inch cupola and the William E. Dee, Co., Harvey, Ill a 48-inch cupola.

Inquiry Brisk in Chicago District

CONSIDERABLE activity is present in the market for foundry equipment, although some foundrymen are holding their purchases until after the end of the year to avoid carrying too much inventory. Every indication is that foundry activity is on the increase and that next year will find most melters busy. This increases demand for equipment to meet the heavier tonnage. New construction and enlargements are coming to the boards of architects and engineers and some plants now under construction are nearing completion. The car wheel foundry of the Pullman Co. is about 50 per cent completed and ground has been broken at Lancaster, Pa., for the plant of the Burnham Boiler Corp. Both of these projects are being directed by Frank D. Chase, Inc., Chicago. This engineer also is undertaking preliminary development plans for a new plant for the Iron City Sanitary Co., Pittsburgh. Numerous projects for enlargements of existing plants are coming up but have not yet developed sufficiently for announcement. Prospects for molding machine buying are promising and numerous sales are being made of single, light machines. The Ford Motor Co. has just made a repeat order for 11 jolt rollover machines from Henry E. Pridmore, Chicago. The General Electric Co. has ordered between 25 and 30 stripping plate and rockover machines from the same seller. The Ford Motor Co., Detroit, has placed an order for 12 helical geared ladles of 1500 pounds capacity with the Whiting Corp., Harvey, Ill.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Work has been started on the erection of an addition, 60 x 240 feet, to the plant of the Duncan Foundry & Machine Works, Alton, Ill.

The New Haven Malleable Iron Co., New Haven, Conn., has increased its capital stock from $50,000 to $150,000.

Erection of additions to its plant at Louisville, Ky., is reported under consideration by the Standard Sanitary Mfg. Co., Pittsburgh.

Capitalized at $50,000 the Niles Furnace Co., Niles, O., recently was incorporated by S. H. Smith, Archie L. Kann, and others.

The foundry and pattern shop of the Velte Foundry & Machine Co., Mars, Pa., recently was damaged by fire.

The Howard Furnace Co., 381 Yonge street, Toronto, Ont., plans the erection of a plant there.

The capital stock of the Motor Castings Co., Milwaukee, has been increased from $15,000 to $30,000. The foundry at 425-429 Fifty-sixth avenue, will be enlarged.

Capitalized at $100,000 the Brantford Brass Foundry Co., Ltd., Brantford, Ont., recently was incorporated by David L. Webster, Alfred Serjeant and Thomas E. Hutton.

Contract has been let by the Adams Pattern & Foundry Co., 6250 South Halsted street, Chicago, for the erection of a foundry building, 24 x 98 feet.

The Fisher-Sweeney Bronze Co., Boundbrook, N. J., whose plant at Hoboken, N. J., recently was damaged by fire, has started work on the erection of a new building, 70 x 185 feet.

The Cincinnati Milling Machine Co., Cincinnati, recently was incorporated with a capital stock of $6,000,000 by Fred A. Geier, C. Wood Walter, and others. The company is an established firm.

Capitalized at $10,000 the Motor Pattern & Machine Co., Ford City, Mich., recently was incorporated to manufacture patterns and special equipment by L. J. Feltes, J. J. Marks and C. A. Brady.

Dayton Steel Foundry Co., Dayton, O., recently ordered a 3-ton Moore electric furnace from the Pittsburgh Electric Furnace Corp., Pittsburgh, for installation in its steel foundry. The old furnace equipment is not sufficient to take care of the company's enlarged business.

The United Engine Machine Co., Fresno, Cal., has been incorporated with a capital stock of $250,000 and will build four buildings including a machine shop, foundry and molding shop, pattern and forge shop. G. J. Dolan Jr. and D. Sulprizio are the incorporators.

The Birmingham Machine & Foundry Co., Birmingham, Ala., one of the largest plants of its kind in the South, has converted one of its departments into a soil pipe making plant. It is announced that during the early part of the year an addition to the foundry will be erected for the sole purpose of manufacturing soil pipe.

Enlargement of the plant of the Alliance Machine Steel Casting Co., Alliance, O., will be made at once following action of the board of directors recently adopting a resolution authorizing the erection of a plant extension. The addition will more than double the floor space of the company's present plant and will be 75 x 600 feet. It is expected to be ready for operation no later than Feb. 15.

Work was resumed recently at the plant of the Duquesne Steel Foundry at Kendall Station, near Coraopolis, Pa., which on Nov. 20 was damaged by fire. Three buildings of the plant, covering 20 acres along the Ohio river were damaged. D. W. Wakefield, president of the company, after a checkup of the damage, said it would be upwards of $100,000. The fire started under the floor of the pattern shop. Work will be started shortly on rebuilding the three shops.

The plant of the Driscoll-Reese Steel Co., Hamburg, Pa., has been bought at receiver's sale by J. A. Gilmore and John G. Thomas, formerly of the Crucible Steel Casting Co., Lansdowne, Pa. Messrs. Gilmore and Thomas will operate the plant as the Pennsylvania Electric Steel Casting Co. The plant built in 1917 and first operated in May, 1918, has a 1-ton electric furnace. It produced small steel and automobile castings and had a capacity of 900 tons annually.

The pump department of the Eclipse works of Fairbanks, Morse & Co., Beliot, Wis., will be moved to the company's works at Three Rivers, Mich., it has been announced by W. C. Heath, general manager. This is being done to clear the way for devoting the entire capacity of the Beliot plant to the manufacture of internal combustion engines of various sizes and capacities for industrial, commercial and agricultural purposes. It was with this development in view the company recently built one of the largest foundries in the country at Beliot.

Construction of a new building, 77 x 393 feet, for the Belle City Malleable Iron Co., at Racine, Wis., is intended for its annealing department only. The company is erecting a continuous annealing kiln in the building which will give it a considerably increased capacity. The necessary equipment has been purchased for this improvement, according to C. S. Anderson, general manager. The company, with the affiliated Racine Steel Castings Co., produces malleable iron castings, railroad specialties, refined electric steel castings and carbon and alloy steel ingots.

Consolidation of the Aetna Foundry & Machine Co., Warren, O., and the Youngstown Foundry & Machine Co., Youngstown, O., will be the probable result when stockholders of the latter company will meet in special session Dec. 23 to discuss a proposal to sell their properties to the Aetna company. Both companies are engaged in building of general steel works equipment and together own three plants, two in Youngstown and one in Warren. If the transaction is consummated a new corporation with a capital stock of about $1,000,000 will be organized. Myrin I. Arms is head of the Aetna company and W. J. Wallis is president of the Youngstown firm.

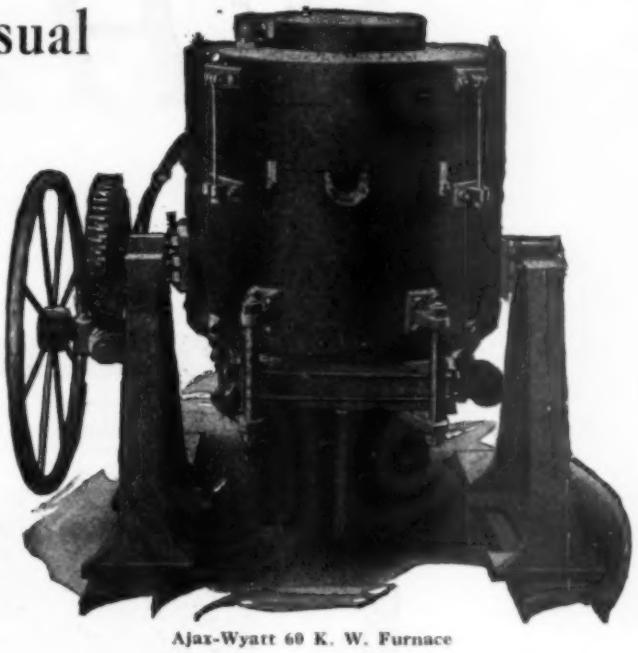
Advices have been received from the Monessen Foundry & Machine Co., Monessen, Pa., regarding the recent fire at its plant. The fire destroyed three pattern storage houses and the core room. The operating end of the plant was not damaged to a great extent. Operation was resumed in the machine shop and brass foundry the day following the fire, and in the iron foundry a day later. The company has completed a new pattern shop which now is ready for occupancy. The Pittsburgh Bridge & Iron Works has received a contract from the company for a building, 32 x 100 feet, to be used as a core room. This will be equipped with a 10-ton crane. Designs are also being drawn for a pattern storage building which is to be 3-stories, 50 x 150 feet.

An "Open Door" to Unusual Melting Results

Lower Fuel Costs—Lower Crucible Costs—Lower Labor Costs—Lower Metal Loss—Improved Working Conditions—Accurate Temperature Control—Increased Production (through the elimination of lost heats and defective castings)—are *doubly* sure, when melting is done with

Ajax-Wyatt Furnaces

Constant, vigorous stirring essential to proper alloying is done automatically. The current in passing *through* the metal sets up a powerful circulation and actually drives the metal round and round in the melting chamber.



Ajax-Wyatt 60 K. W. Furnace

Partial List of Installations

	Initial Order	Trial Period	Now Using
American Brass Co.	2 furnaces	1 yr.	80 furnaces
Bridgeport Brass Co.	2 furnaces	1½ yr.	24 furnaces
Chase Metal Works	1 furnace	1 yr.	8 furnaces
Rome Brass & Copper Co.	1 furnace	1 yr.	10 furnaces
Scoville Mfg. Co.	1 furnace	1 yr.	14 furnaces
Baltimore Tube Co.	1 furnace	9 mo.	4 furnaces

Don't these figures convince you that it will be a good plan to try an "Ajax-Wyatt" on your production?

Your Guarantee of Perfect Castings at a Lower Cost Per Pound.

A trial will convince you that a reliable ingot is much cheaper in the long run than scrap.

Scrap gives a high percentage of defective castings, therefore it is the most expensive metal possible.

Ajax Process Ingots are *absolutely reliable.* They are made by a special Ajax Alloying Process—and are guaranteed to be true to specified formula. Defective castings become a thing of the past after Ajax Process Ingots are adopted.

Ajax Process Standard Ingots

Ajax Plastic Bronze
Ajax Phosphor Bronze
Ajax Red Brass Ingots
Ajax Manganese Bronze
Ajax Anti-Acid Bronze
Ajax Hydraulic Bronze
Ajax Golden Glow Brass
Ajax Manganese Copper
Ajax Phosphor Copper
Ajax Silicon Copper
Ajax Phosphor Tin

May we have a trial order?

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LINOIL
It wouldn't be such a bad Xmas gift to your business, at that- A drum of Linoil certainly would be conducive to a Happy and a Prosperous New Year

YOU WANT CORE OIL?

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Absolute Uniformity?
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The Logical Oil for Cores, combines all of these qualities. Linoil is a scientific core oil developed to meet modern requirements of the foundry.

One drum will show you why Linoil is the choice of the majority of American foundries. Hadn't you better try it?

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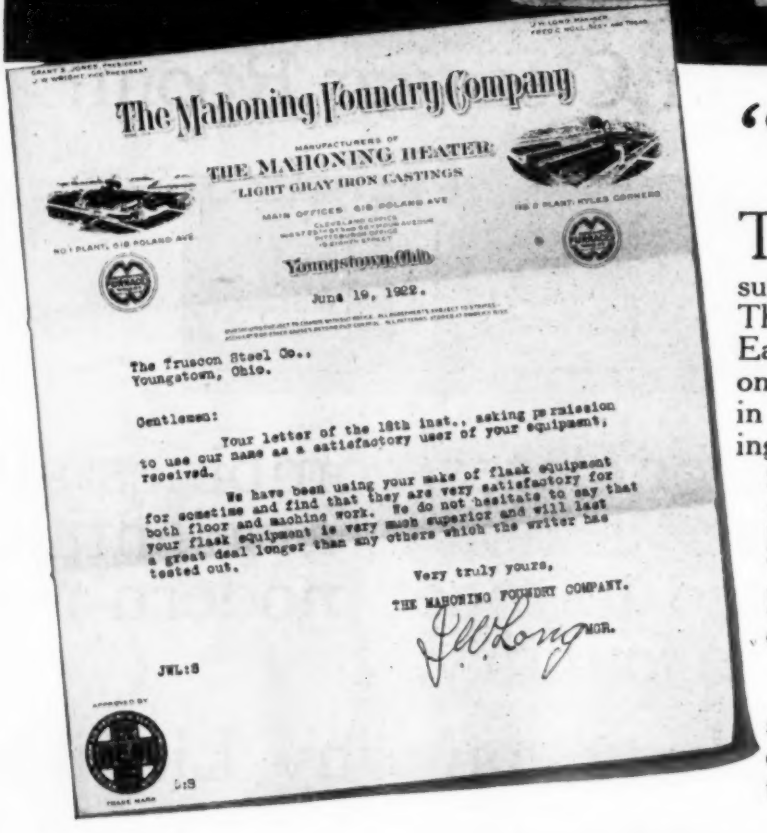


The Mahoning Foundry Company

MANUFACTURERS OF
THE MAHONING HEATER
LIGHT GRAY IRON CASTINGS

MAIN OFFICES 618 POLAND AVE

Youngstown Ohio

June 19, 1922.

The Truscon Steel Co.,
Youngstown, Ohio.

Gentlemen:

Your letter of the 18th inst., asking permission to use our name as a satisfactory user of your equipment, received.

We have been using your make of flask equipment for sometime and find that they are very satisfactory for both floor and machine work. We do not hesitate to say that your flask equipment is very much superior and will last a great deal longer than any others which the writer has tested out.

Very truly yours,
THE MAHONING FOUNDRY COMPANY.
J.W. Long MGR.

JWL:S

"None Superior"

THE letter from the Mahoning Foundry Company is just another proof of the superiority of Truscon Alloy Steel Flasks. The picture shows a few 14" x 20" flasks. Each cope and drag is readily handled by one man. Notice the close fit of the pattern in the flasks shell. That means a big saving in sand and labor. Compare Truscon flasks with the bulky old wood flasks in the background of the picture and see how much floor space is saved. Rigid Truscon construction stands the daily knocks. The heavy pins and brackets do not get out of alignment.

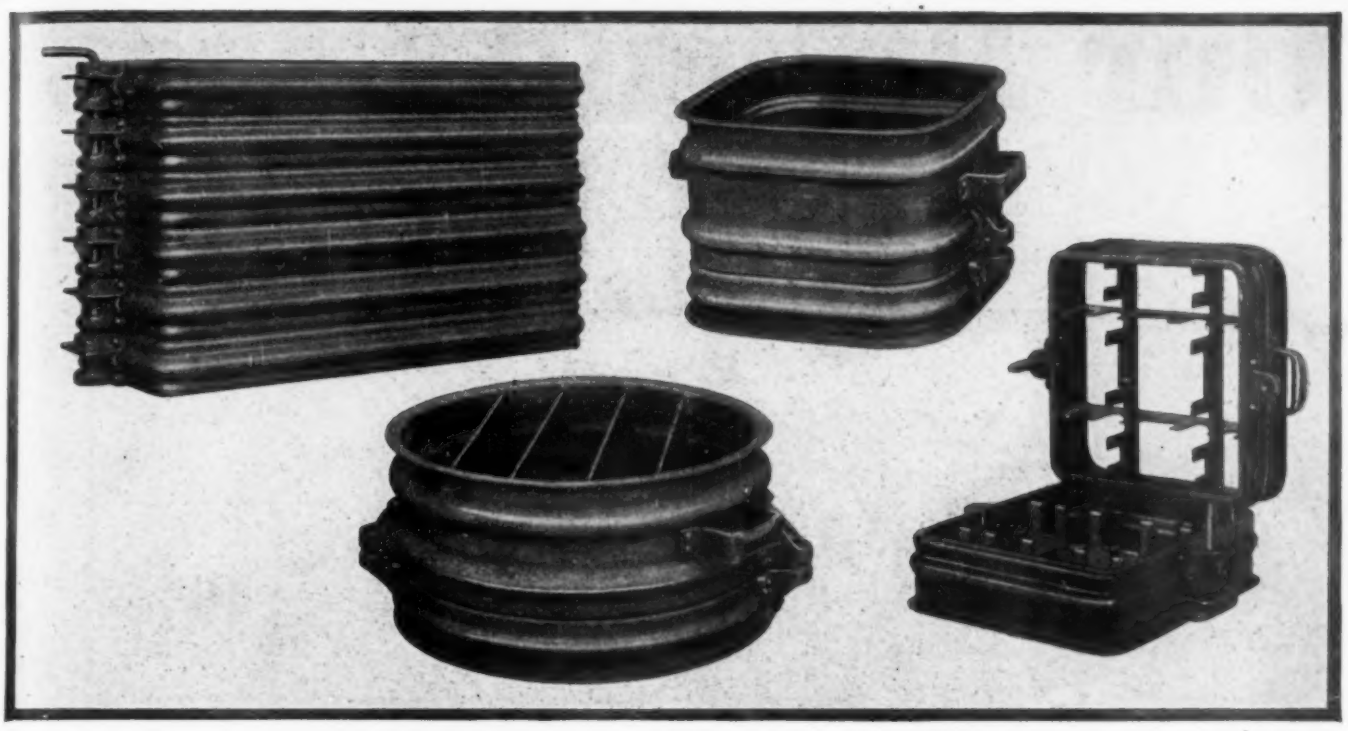
Is it any wonder that Truscon rust resisting alloy steel flasks are the standard of equipment in more than a hundred of the country's largest foundries?

TRUSCON STEEL COMPANY

General Offices and Plant YOUNGSTOWN, O.

TRUSCON ALLOY

FOUNDRY PRODUCTS



Designed for the Job

Here are four examples of Truscon Alloy Steel Flasks that are typical standards of foundry equipment.

Whether they are batteries of double faced sections, fly wheel or piston flasks—if they are Truscon construction they will stand the severe wear and tear they are bound to get in every day service.

Truscon Alloy Steel Flasks lower production costs.—The famous Truscon ribs save sand.—The lightness of the flask sections increases speed in handling.—Accurate alignment of the pins and brackets insures close matching of cope and drag.—Scrap is reduced to a minimum.

No matter how small or how large, or how complicated your requirements, Truscon Alloy Steel Flasks will fill them because they are designed for the job.

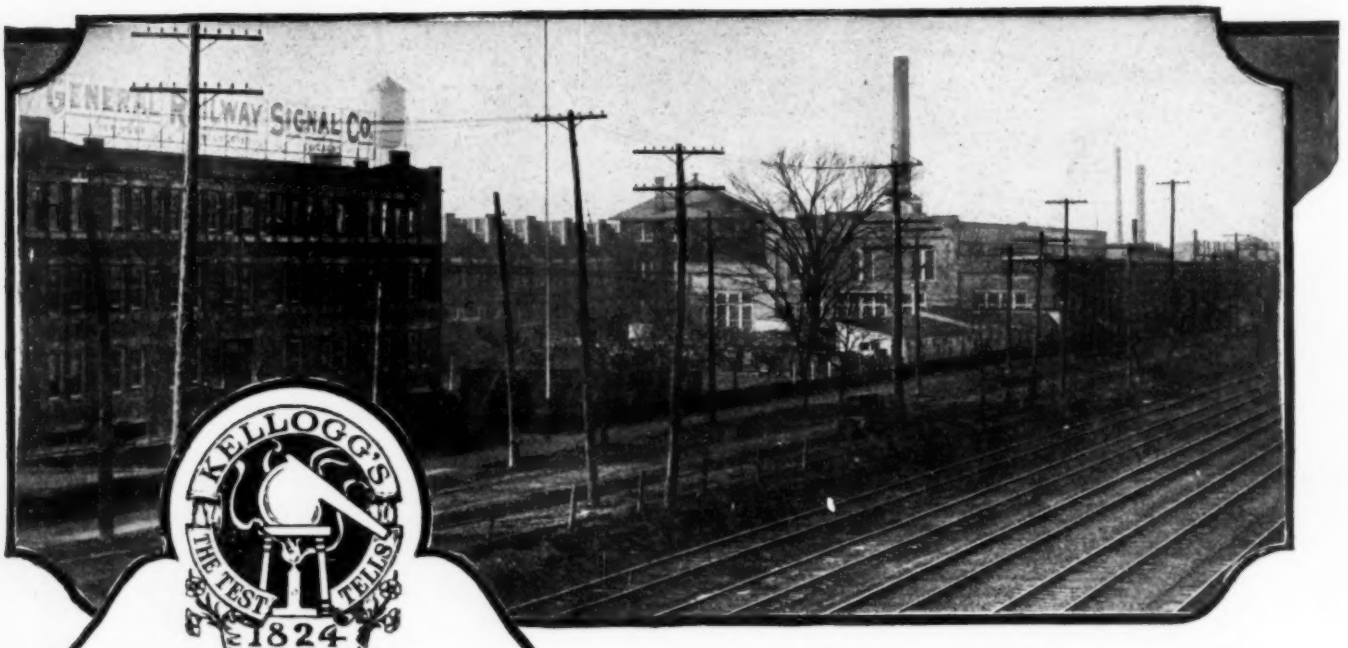
If you want to know what some of our customers think write for this booklet.

FLASKS STEEL

SPECIAL REPRESENTATIVES

New York, Chicago
Philadelphia
Detroit, Pittsburgh
Cleveland, Buffalo

"Our Difficult Cores Highest



KELLOGG'S
THE TEST TELLS
1824

GENERAL RAILWAY SIGNAL CO.
ROCHESTER, N. Y.

KELLOGG'S CORE OILS

Kelloil
Gold Bond XX
Cylinder Core Special
Gold Bond
Radiation Special
No. 10
Skasco

Ask for shipment from our nearest warehouse or tank station.

KELLOGG'S

Require Grade Core Oil"

General Railway Signal Co.

Cores like theirs—made in large quantities—demand a core oil that not only has the highest possible quality, but that runs uniform.

"G. R. S." has used Kellogg's Core Oils for many years. In speaking of this a few days ago, Mr. Poole, their Foundry Superintendent, strongly emphasized the fact that he could always depend upon their uniformity.

The core oils listed cover a wide range of work. We shall be glad to make a study of your core-room problems and recommend the oil best suited to your work.

Spencer Kellogg & Sons, Inc.

Buffalo, N. Y.

**All our core oils are linseed base.
We are the only manufacturers
of core oils who make linseed oil.**

**Minneapolis Chicago Boston Philadelphia
Cincinnati Cleveland New York City St. Louis
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CORE OILS

Dustless **Improved** **Efficient**

Paxson Sand Blast Machines

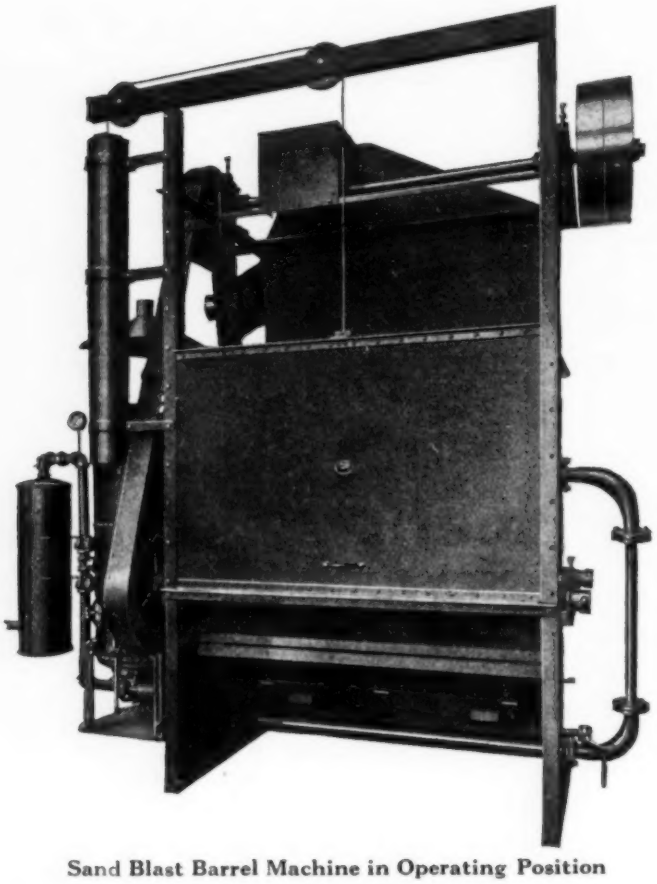
designed by

H. F. Hoevel

Automatic **Self-Contained** **Economic**

Steel Tires are shrunk on the heavy cast iron heads.

The charge can be dumped into an ordinary wheelbarrow or into boxes on trucks. If desired we can furnish dumping chute so that the charge may be dumped on the floor.



The nozzles point nto the barrel through a small hole in the end walls so that the barrel is entirely free and unobstructed inside.

The slanting end walls force the charge to roll sideways besides the turning over effected by the rotation of the barrel, thus securing quick and uniform cleaning.

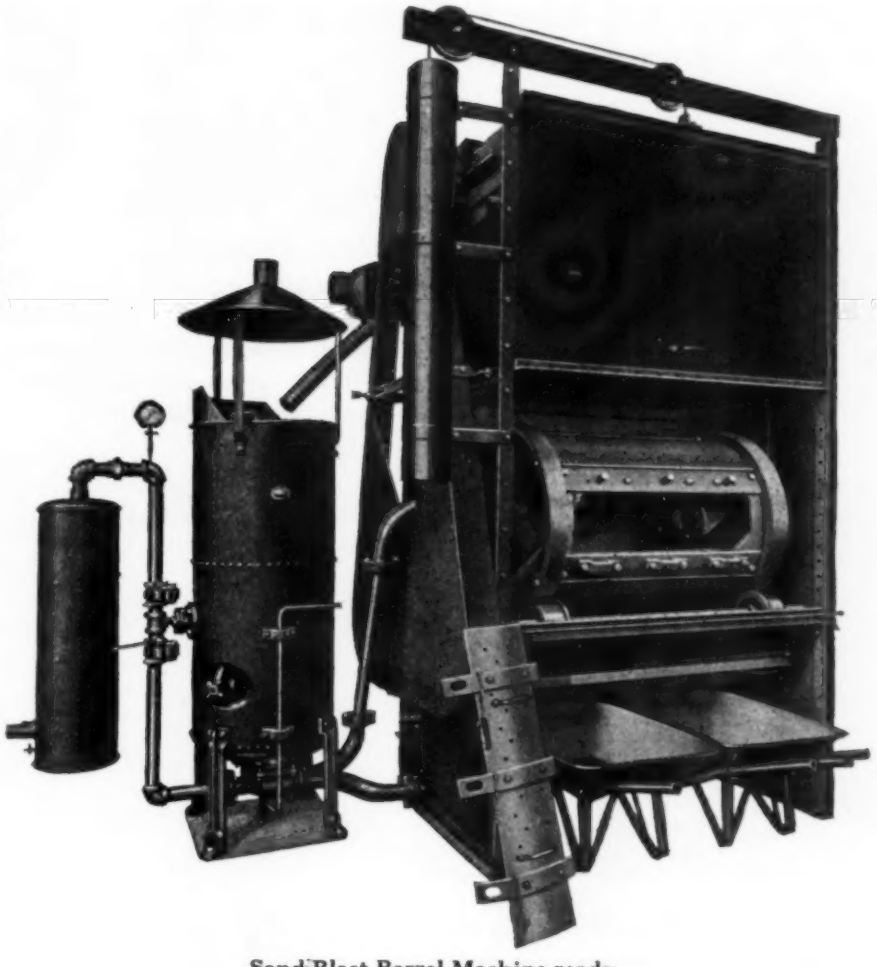
Sand Blast Barrel Machine in Operating Position

All our sand blast machines have the following advantages and many others; we use the direct pressure system which effects the most thorough and efficient cleaning at minimum cost and in the shortest time possible. The air carries the sand to nozzles through pipes made of steel and hard iron exclusively, heavily reinforced at the curvatures, insuring minimum of wear and tear. Our dust separator efficiently removes the dust from the sand so that only clean sand will be re-used. The automatic filling valve in the sand blast tank opens automatically as soon as the compressed air has been turned off and allows refilling of the tank in little more than one minute. It closes automatically as soon as the compressed air is turned on. Our sand regulating valve allows an easy regulation of the sand or steel shot without getting clogged. Our machines are non-dust spreading, the dust being removed by an exhaust fan.

We build a complete line of sand blast machines and equipment for all purposes, especially *hose sand blast machines, sand blast barrel machines, sand blast table machines, sand blast rooms, sand blast cabinets, dust collectors and all kinds of special sandblast equipment.* Many hundreds of our machines are in operation all over the country. A number of them have been in service for twenty years.

All our equipment is built in our own plant in northern Philadelphia which is located on a five-acre lot, has a P. R. R. siding and is fully equipped with the most efficient machinery for economic manufacturing.

The barrel rotates 3 R.P.M. turning over the parts to be cleaned. The cleaning is done by sand blasting, not by tumbling.



The sand blast barrel machine is the best equipment for cleaning small and medium sized castings as the sand blasting is done entirely automatically, thereby greatly reducing the time and the cost of cleaning.

Sand Blast Barrel Machine ready to dump into wheel barrows

J. W. PAXSON CO.

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Your Cleaning Cost is Governed by Your Output

PANGBORN Sand-Blast Hose

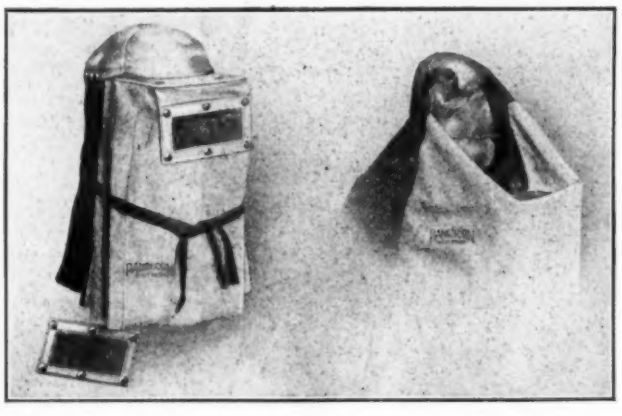
has an inner tube that is resilient and resists wear —it's a full quarter inch tube—it lasts longest and costs the least per ton cleaned.

NEW WORN

NOTE—Constant air inlet—No increased air flow

PANGBORN "V" Type Sand-Blast Nozzles

(Patent applied for) have "Most metal where the wear comes". More continuous operation through less frequent renewal means more output per hour—and they don't enlarge with use —keep air flow constant.



"Pangborn" Shotpruf hoods are light, strong and vented. Chrome leather caps, and cape resist metallic abrasives, and last correspondingly longer with sand.

Operators that work in comfort work steadier and turn out more tonnage

"Shotpruf" heavy Chrome Leather Aprons protect the clothing as no cloth can.

Easy on and off and held in position to the legs by spring clips that hold but do not bind. Useful in every department.

Other types of hoods, ventilated helmets, rubber and leather, gloves and respirators.

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FREIGHT STORAGE AND HANDLING

on carloads of Sand-Blast Abrasive that goes into dust and then paying to cart the dust away?

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One ton of

Metallic Abrasives

will do as much work as a carload of sand, and the operator works in comfort with Clear Vision that means More Production—Lower Cost.

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SEATTLE
SPRINGFIELD
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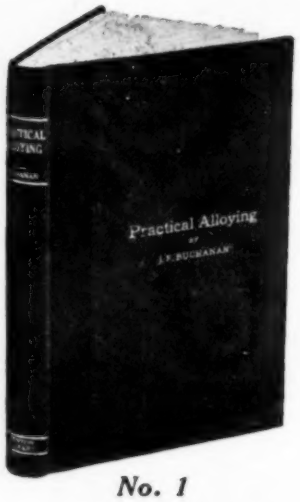
P. O. Box 851

Ideal Christmas Gifts



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By J. F. Buchanan

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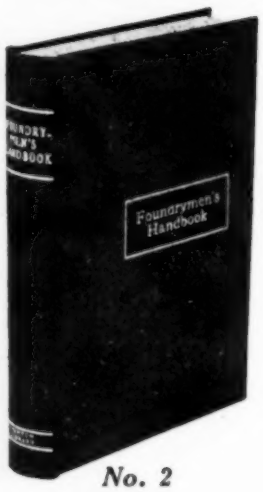
This treatise is one of the most comprehensive and thorough works on alloying that has ever been published. It is a guide, a hand book, and a text book on the casting of non-ferrous metals for brass founders, metal workers and engineers.

In addition to solving those problems that you meet daily, the author has prepared a set of tables which alone are worth the price of the book.



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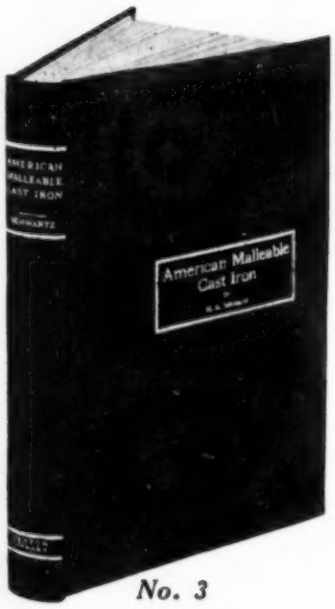
This book contains the most complete collection of formulas, tables, weights, specifications and information relating to foundry work ever gathered together. It is a compilation of **THE FOUNDRY'S "Data Sheets"** revised and brought up-to-date with much additional information.

It is invaluable to the foundryman, the pattern-maker, the metallurgist and the student. It gives you in the most convenient form exactly the information you need to successfully solve any problem that may arise in your foundry operations.



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This volume is the first complete treatise on "black heart" malleable iron ever published. It covers the history of the malleable industry—its development, modern methods of manufacture, metallurgical principles involved and the properties and uses of American malleable cast iron.

It also includes a detailed list of all the important books and articles on malleable iron ever published, and represents the only reference work available on the subject. The metallurgist, engineer and foundryman interested in malleable cannot afford to be without a copy of this book.

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For Foundrymen

Tales From the Gangway

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Thousands of readers of **THE FOUNDRY** all over the world who have chuckled inwardly over the experiences of Bill and laughed outwardly over the clever cartoons that illustrated the series of articles written by Pat Dwyer will welcome this opportunity of securing these stories in permanent book form.

We have prepared a limited edition containing sixty of these intimate glimpses of foundry life under the title **"Tales From the Gangway."** Each story deals with some specific phase of American foundry practice and is based to a considerable extent on the author's personal experience of 27 years in the foundry, supplemented by four years' affiliation with **THE FOUNDRY,** during which time he visited and studied at first hand the methods employed in many of the leading plants in this country.

If you want to treat yourself or any of your foundry friends to a real Christmas present, one that breathes the genuine atmosphere of the foundry, written from the inside by practical men, sign this coupon today and send it in. You may have your copy or copies addressed to yourself or to any person you may designate.

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We will enclose with every book you order, a handsome Christmas Card with your name on it and the Season's Best Wishes.

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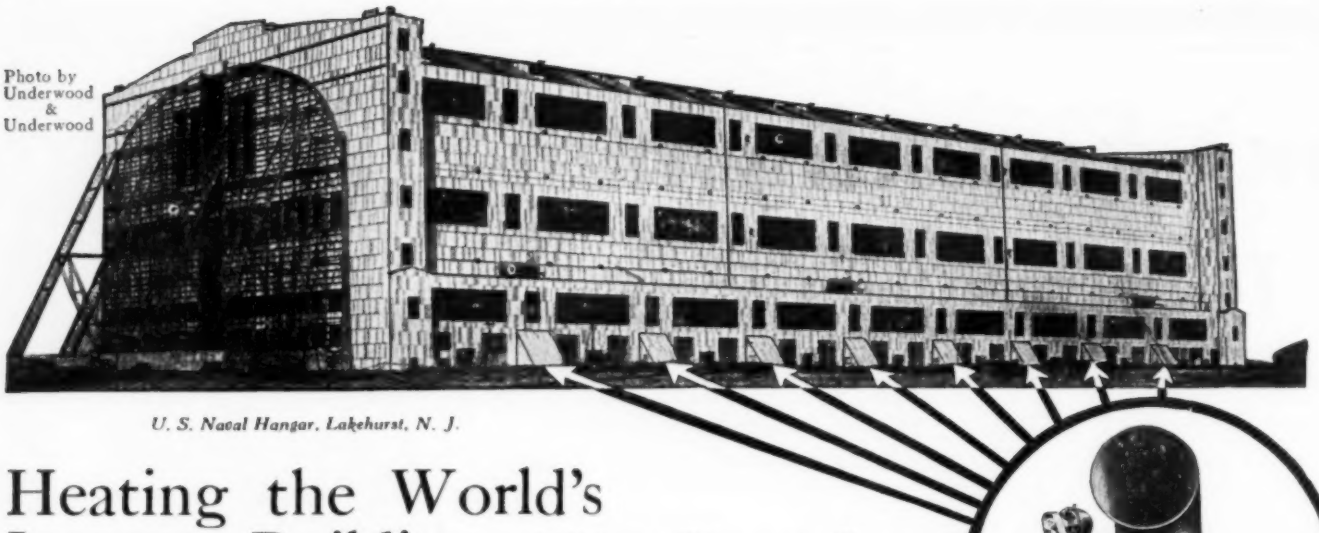

Photo by Underwood & Underwood

U. S. Naval Hangar, Lakehurst, N. J.

Heating the World's Largest Building *Without Pipes or Ducts*

THIS enormous hangar represents a single open space with a volume of over 57,000,000 cu. ft. It is the largest open space ever enclosed by four walls and a roof and, when it was built, presented the most gigantic heating problem ever encountered.

Many thorough tests and investigations were made of different types of heating systems, with the final result that 16 Skinner Bros. (Baetz Patent) Heaters were installed in a series of specially constructed lean-tos, 8 along each side of the building. The marvel of the installation is indicated by the fact that the space occupied by all 16 heaters represents a volume of less than 6000 cu. ft. as compared with the volume of over 57,000,000 cu. ft. of air heated.

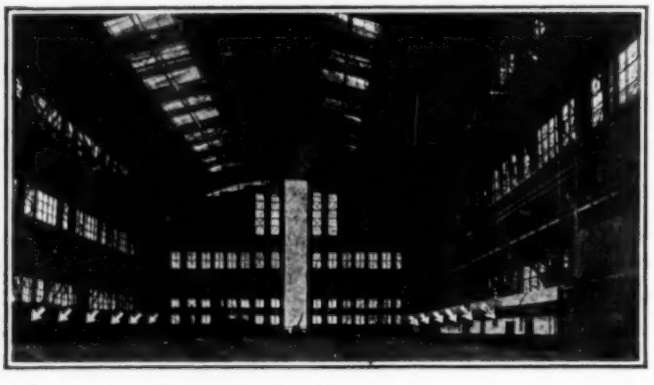

Photo by Underwood & Underwood

Illustration shows partial view of interior of the Lakehurst hangar, which is approximately 800 feet long, 357 feet wide and 200 feet high. Sixteen heaters heat this vast volume of air—a feat almost as remarkable as the building itself. White arrows near the floor indicate the openings through which warm air enters building from heaters installed in lean-tos outside.

Pioneers in Ductless Industrial Heating

Skinner Bros. produced the first Baetz Patent ductless heater. At that time the idea of ductless heating met with question and skepticism but the heater proved itself so conclusively that now it is in literally thousands of industrial buildings of every type and character. Repeat orders from national institutions form the best evidence of its satisfactory performance.

With the Skinner Bros. (Baetz Patent) Heating System no distributing pipes or ducts are used as warm air carriers, but an even, steady warmth is maintained throughout the building, and space within the heated area is kept free and unobstructed. Operates with live or exhaust steam at any pressure. Where steam is not available we supply our direct-fired type, which burns coal, coke, wood, gas or oil. Installation and operation costs are unusually low.

Every Skinner Heater is fully guaranteed when installed as directed by our engineers after a survey of the premises. Write today for full information and list of prominent users, so you can make your own investigation.

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Chicago, 1711 Fisher Bldg.
Cincinnati, Ohio
Cleveland, 620 Marshall Bldg.
Detroit, 316 Scherer Bldg.
Kansas City, 335 Lee Bldg.
New York, 1710 Flatiron Bldg.
Pittsburgh, 8 Wood St.
San Francisco, Monadnock Block
Spokane, 417 First Ave.
Washington, D. C., 722 Evans Bldg.

Skinner Bros.

Baetz Patent HEATING SYSTEM

$12,000,000 in 120 Foundry Jobs
30% of them REPEAT ORDERS
comprising

- New Plants
- Old Ones, Revamped
- Extensions
- Advisory Reports on Future Changes
- Powdered Coal, Fuel Oil, Mechanical Equipment, etc.

THERE MUST BE A DIFFERENCE

between the foundry which is just so much floor space under roof and the one which has been designed primarily for the purpose of making possible the lowest casting costs.

WE REGARD A FOUNDRY AS A MACHINE ON A LARGE SCALE

YOU can employ any one of a dozen firms to make plans or build, BUT you engage us for the larger purpose of obtaining the plant which is the most profitable from the standpoint of first cost and operating costs. Such a plant, not a mere building, costs no more, often less, and takes no longer to build.

We are interested not so much in the size of a job as the opportunities it offers of putting our knowledge and experience to your good use.

A STUDY OF YOUR CONDITIONS by experienced foundry engineers will bring a fresh viewpoint and may result in improvements which have never occurred to you.

A CRITICAL SURVEY of what you are doing and a report recommending what practical improvements can be made, may cost as much as a hand squeezer.

WHY BE A SCEPTIC when you can ask any of our clients what we have done for them.

If we cannot do anything for you, we will cheerfully admit it.

Our booklets and a talk about your problem will cost you nothing.

A Partial List of Clients

American Steam Pump Co.
B. F. Avery & Sons
H. & B. American Machine Co.
2 Baltimore Malleable Iron & Steel Casting Co.
Burnham Boiler Corp.
3 E. W. Bliss Company
6 Bucyrus Company
Cadillac Malleable Iron Co.
3 Chain Belt Company
Chicago Steel Foundry Company
2 James B. Clow & Sons
4 Cribben & Sexton Company
Des Moines Foundry & Machine Co.
2 Electric Steel Company
Elmwood Castings Co., The
Eriez Stove & Mfg. Co.
W. W. Fowler, China
3 General Motors Corporation
Gilliam Mfg. Co., The
G. A. Gray Company, The
Green Foundry & Furnace Works
Griffin Wheel Company
Hamilton Foundry & Machine Co.
2 Haskell & Barker Car Co., Inc.
Hoosier Iron Works
International Harvester Company
2 Iron City Sanitary Mfg. Co.
Johnson Bronze Company
3 Link-Belt Company
Lunkenheimer Company, The
Manning, Maxwell & Moore, Inc.
A. Y. McDonald Mfg. Co.
McKinnon Industries, Ltd.
Michele Ansaldi, Torino, Italy
3 Moline Malleable Iron Co.
3 Ohio Steel Foundry Co., The
Pangborn Corporation
3 Peerless Foundry Company, The
Pittsburgh Malleable Iron Co.
A. Plamondon Mfg. Co.
The Pullman Company
3 Saginaw Malleable Iron Co.
Samson Tractor Company
Geo. H. Smith Steel Castings Co.
H. B. Smith Co., Westfield
Southern Wheel Company
St. Louis Malleable Casting Co.
Temple Malleable Iron & Steel Co.
Temple Pump Co.
Wanner Malleable Iron Co.
3 Vermilion Malleable Iron Co.
The Western Foundry Company

Numbers indicate Repeat Orders

FRANK D. CHASE, Inc.

ENGINEERS and ARCHITECTS

CHICAGO

GEORGE F. PETTINOS
SANDS AND SUPPLIES — PLUMBAGO FACINGS

A Heat Proof Blanket for Your Moulds

GEOGRAPH
CEYLOGRAPH
MEXIGRAPH
Plumbago Facings

By using these super-quality facings you will make clean, smooth and attractive castings doubly sure; you will save hours of cleaning and chipping. Our facings are easily and quickly applied, and form a perfectly fire-proof skin on the moulds—a skin that effectively resists the flow of metal.

May we send you a sample?

If you are pleased with the appearance of our facing we would like to send you a barrel on trial, under the conditions, that if it does not perform in a satisfactorily manner, you can return it to us at our expense. *What offer could be fairer or more to your advantage!*

GEORGE F. PETTINOS

1206 Locust Street, Philadelphia, Pa.

200 Devonshire Street
BOSTON, MASS.

50 Church Street
NEW YORK CITY

GEORGE F. PETTINOS
SANDS AND SUPPLIES — PLUMBAGO FACINGS

Canadian Representative—R. J. Mercur & Co., Ltd., Montreal

THE KELLY GRAPHITE MILLS

STOCKERTOWN, PA.

Owned and Operated by

T. P. KELLY & CO., Inc.

NEW YORK

BRANCHES:
Philadelphia, Pa.
Hamilton, Ohio
Chicago, Ill.
Worcester, Mass.

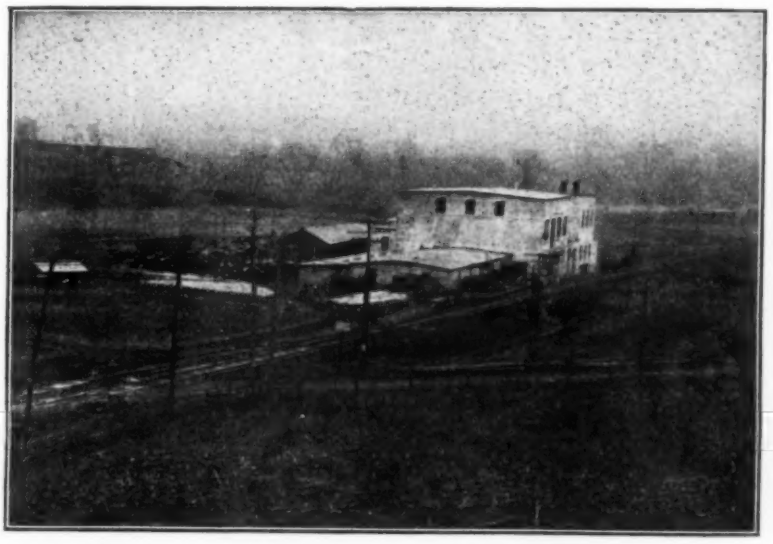
The Home of Kelly Facings

THE BEST

Kelco Ceylon Lead

Air-floated Graphite and Plumbago

Kelly's Crystal Blacking



Heavy Stoveplate Facing

Pipe Blacking and Mineral Facing

Seacoal Facing

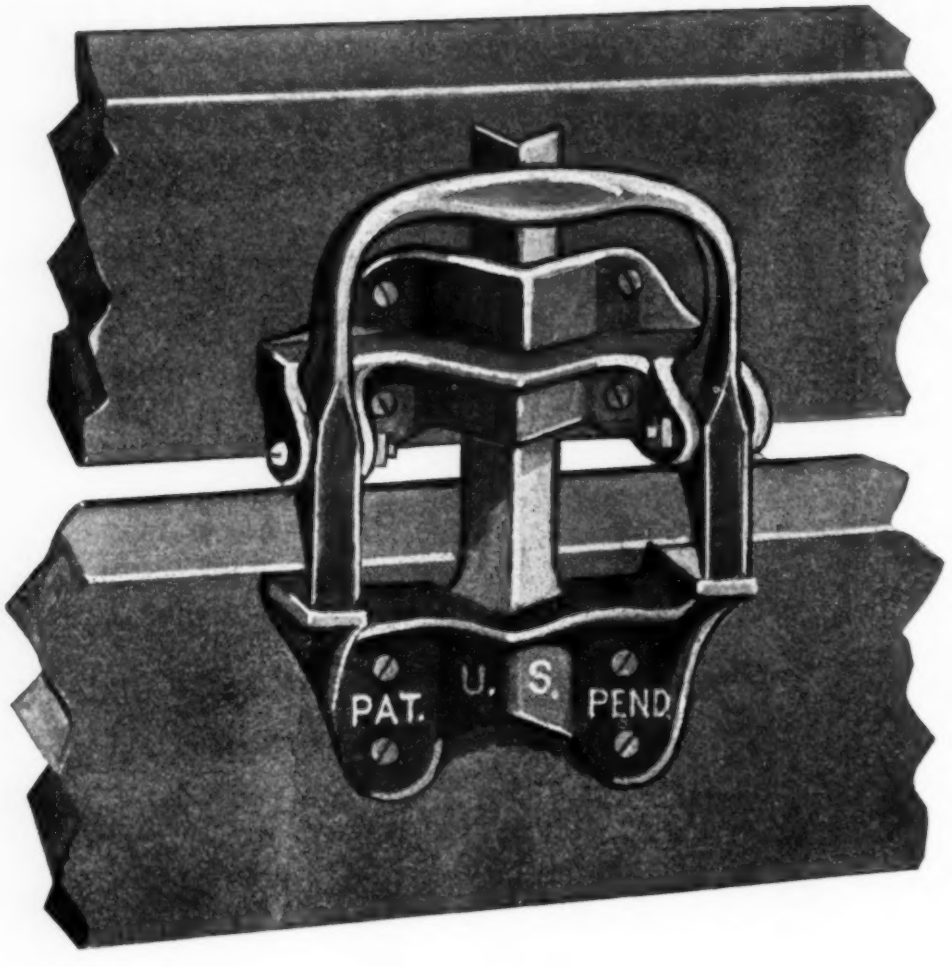
USE
KELLY FACINGS
BEST
BY TEST

We have low labor costs—low overhead—a new and the most modern facing mill in the country, making it possible for us to sell direct to foundries best quality material at attractive price.

We are jobbers of Glutrin and Goulac

U Selling Co.

To be happy and prosperous this coming NEW YEAR equip your Snap and Floor Flasks with U. S. Cope Lifters.



Order now and take advantage of our Special 25% discount to be in effect for 30 days from December 15, 1922 to January 15, 1923.

U. S. SELLING CO.

2757 N. Washtenaw Ave. **Chicago, Ill.**

Saves 25 to 50 Per Cent of Binder Cost!

To prove this claim is not made at random we will gladly ship

BINDARENE

LIQUID and DRY

—on Approval

There's no better time than now to let "Bindarene" show you that it is in a class by itself both in efficiency and economy.

Order a supply from us, or from any of our representatives as listed below, with the understanding that there'll be no charge if "Bindarene" should not come up to your expectations.

International Paper Company

Bindarene Sales Dept.
Palmer, N. Y.

The E. J. Woodison Co., Detroit, Mich., Boston, Mass., Buffalo, N. Y., Cleveland, Ohio, Indianapolis, Ind., Seattle, Wash., St. Louis, Mo., Milwaukee, Wis., Philadelphia, Pa., J. S. McCormick Co., Pittsburgh, Pa., J. W. Paxson Co., Philadelphia, Pa.

Springfield Facing Co., Springfield, Mass.
New York Sand & Facing Co., Brooklyn, N. Y.
American Oil & Supply Co., Newark, N. J.
James Supply Co., Chattanooga, Tenn.
Distributed throughout the Dominion of Canada by The E. J. Woodison Co., Ltd., Toronto, Windsor and Montreal

Sterling Veterans

Spring City Foundry Co., Waukesha, Wis.

Service Record

Years in service—4 years. Nature of casting—Fly Wheel Housing. How Used—Power Bumper. Size of flask—26" x 26" x 7" Cope x 4" Drag. Weight of Flask—including bars 180 lbs. Flasks of this size in use 150. Total Sterling Flasks in use 3,186.

Citation

A flask for our work must be extremely accurate.

It must lay level on our machines and must be interchangeable.

The Sterling Flask successfully meets these requirements, and is also a light flask to handle.

Yours truly,

C. Reechl Mgr.

Better Enlist Sterlings For Your Service

The Only Line Of Rolled Steel Flasks

STERLING WHEELBARROW COMPANY

STERLING ON A WHEELBARROW MEANS MORE THAN STERLING ON SILVER

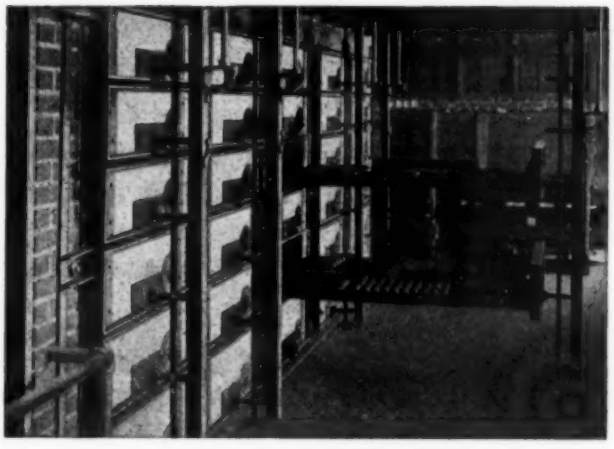
NEW YORK
BOSTON
CLEVELAND

MILWAUKEE, WIS.

CANADIAN AGENTS MUSSENS LIMITED, MONTREAL, TORONTO, WINNIPEG, VANCOUVER

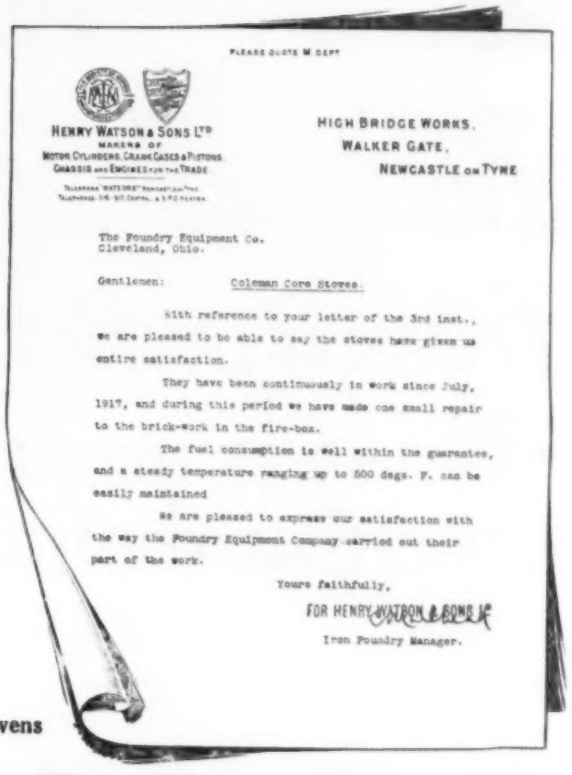
DETROIT
CHICAGO
ST LOUIS

From Conservative Britain



A typical installation of Coleman Rolling Drawer Core Ovens as installed at Henry Watson & Sons, Ltd., Newcastle on Tyne, England.

Among other foreign installations of Coleman Ovens, is one at the Imperial Naval Arsenal, Kobe, Japan.



PLEASE QUOTE M DEPT

HENRY WATSON & SONS LTD
MAKERS OF
MOTOR CYLINDERS, CRANK CASES & PISTONS
CHASSIS AND ENGINES FOR THE TRADE

HIGH BRIDGE WORKS,
WALKER GATE,
NEWCASTLE ON TYNE

The Foundry Equipment Co.
Cleveland, Ohio.

Gentlemen: Coleman Core Stoves.

With reference to your letter of the 3rd inst., we are pleased to be able to say the stoves have given us entire satisfaction.

They have been continuously in work since July, 1917, and during this period we have made one small repair to the brick-work in the fire-box.

The fuel consumption is well within the guarantee, and a steady temperature ranging up to 500 degs. F. can be easily maintained

We are pleased to express our satisfaction with the way the Foundry Equipment Company carried out their part of the work.

Yours faithfully,
FOR HENRY WATSON & SONS LTD
Iron Foundry Manager.

"Complete Satisfaction"—the experience of every user of Coleman Ovens

COLEMAN
CORE AND MOLD OVENS

are built in all types to suit local core room and foundry conditions.

PORTABLE RACK OVENS **CAR TYPE OVENS**
ROLLING DRAWER OVENS **SHELF OVENS, etc.**
Any fuel—coke, coal, oil, gas, etc.

Coleman Ovens are the most modern in design. The knowledge gained in years of experience and hundreds of successful installations are back of every oven we build. Exclusive, patented features assure an efficiency of operation not available in any other type of oven construction.

Write Today for Complete Coleman Oven Catalog-22

Some Representative Users of Coleman Ovens

Allis-Chalmers Mfg. Co.
American Foundry Co.
American Radiator Co.
Chicago Hdwe. Fdy. Co.
Buick Motor Co.
Erie Forge Co.
Fairbanks Morse & Co.
Falk Corporation
Fulton Iron Works
Gisholt Machine Co.
Hoover Suction Sweeper Co.
International Harvester Co.
Lewis Fdy. & Mach. Co.
Lorain Steel Co.
Lycoming Motors Corp.
H. Mueller Mfg. Co.
Otis Elevator Co.
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Pratt & Letchworth Co.
Stearns Motor Mfg. Co.
U. S. Malleable Iron Co.
U. S. Navy Yards
Western Foundry Co.
Westinghouse Elec. & Mfg. Co.

The Foundry Equipment Company

Builders of Coleman Ovens and Furnaces
Engineers and Manufacturers

1831 Columbus Rd. N. W. **CLEVELAND, OHIO**

1 or 2 Moulds from a pattern -Does it pay to machine mould?

ACCORDING to the testimony of scores of Foundries it most emphatically does pay to machine mould 1 or 2 mould runs on Roll-Over Jolt Moulding Machines, providing the pattern is not to be thrown away after the first moulding.

They use just one or two flasks, making the castings as required and then storing the pattern until needed again, rather than running six months requirements at a time. This saves a useless expenditure of money for flasks.

To change patterns takes very little time. In fact, it does not take as long to place the pattern on the table of the moulding machine as it does, when the mould is made by hand, to clear and level off a space on the moulding floor preparatory to starting the mould.

For a jobbing run of 1 or 2 off, or for long run production, it's all one. Join the profit makers. Put your Foundry in the running by ROLL-OVER-JOLTING YOUR MOULDS.

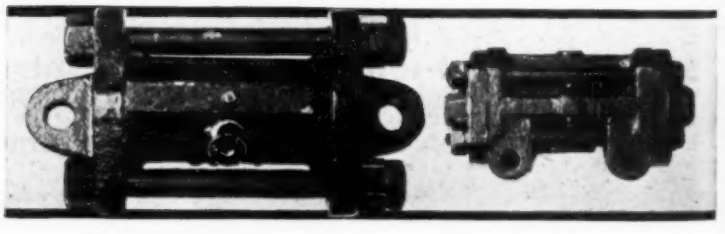
THE OSBORN MANUFACTURING COMPANY
INCORPORATED

New York Chicago **CLEVELAND** Detroit San Francisco

OSBORN VIBRATORS are built with just one aim in view—to give steady, constant, effective service. All of which they are doing for others and will do for you.

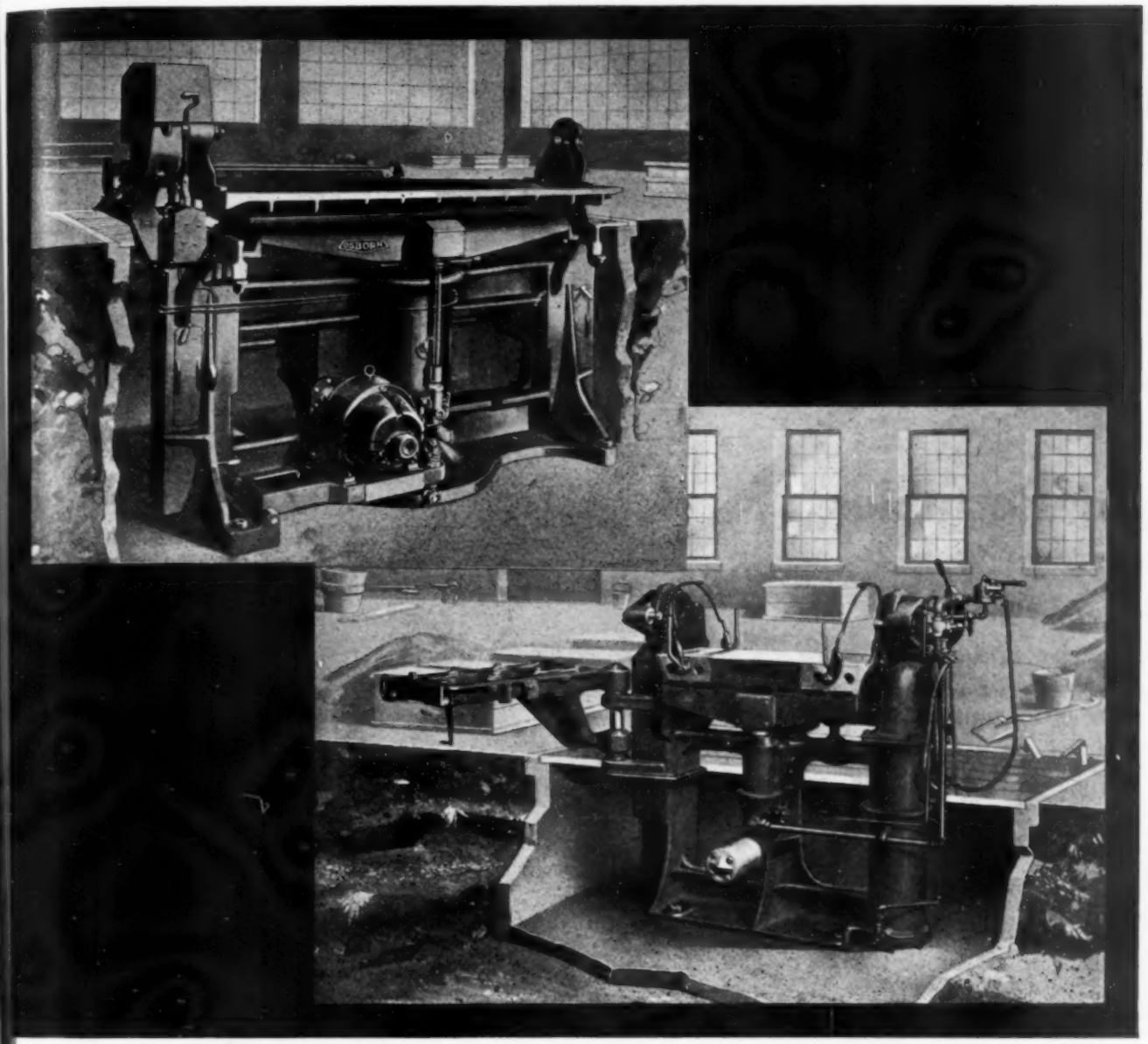
They are made in the following sizes

No. 10 — size, inches	½	No. 12 — size, inches	1
No. 10 — " "	⅝	No. 12 — " "	1¼
No. 10 — " "	¾	No. 14 — " "	1⅞
No. 11 — " "	1	No. 16 — " "	2½

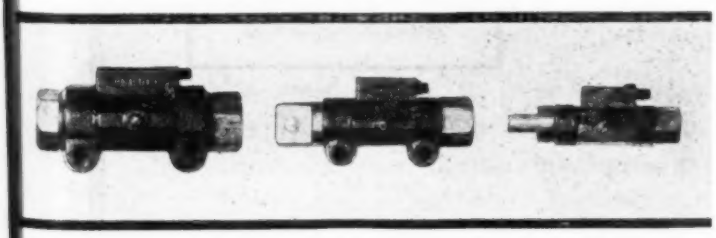


OSB

Moulding



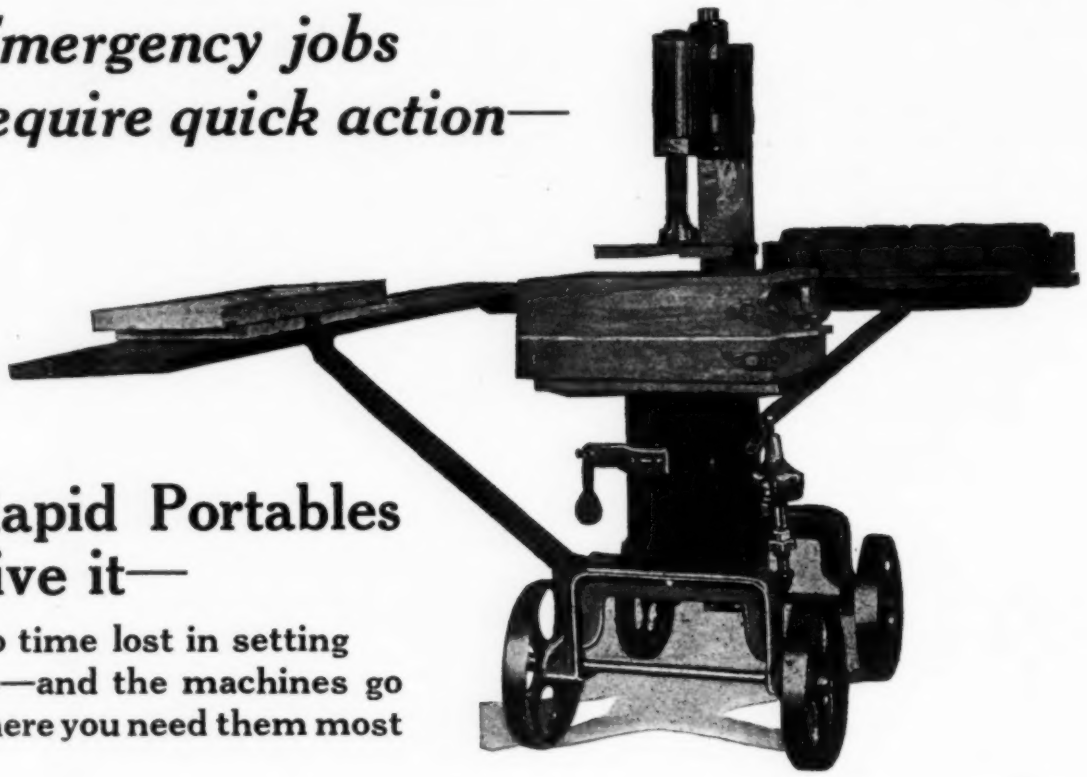
The two extremes of the Osborn Roll-Over Jolt Line. Starting with the 403 at the bottom, which is the "baby" of them all, and ending with the great 409-E, shown at the top, which has an electrically operated roll-over, pattern draw and run-out car, the selection offered is most complete. Write for a catalogue showing all of the members of this profit making line. ARE YOU ROLL-OVER-JOLTING YOUR MOULDS?



ORN Machines

"Make it on a Rapid"

Emergency jobs require quick action—



Rapid Portables give it—

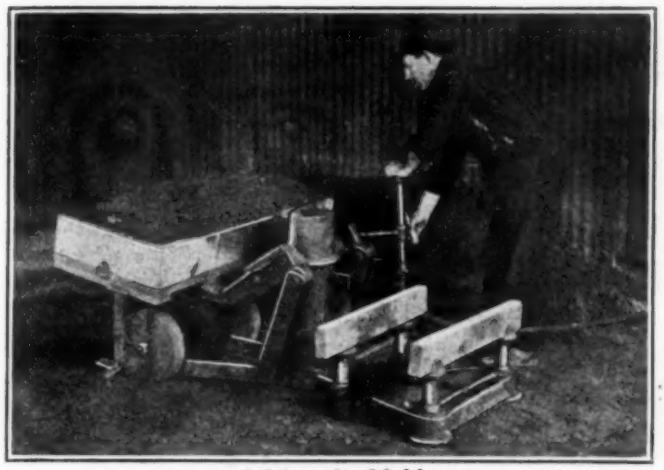
No time lost in setting up—and the machines go where you need them most

Over 300 Foundries are doing it THIS way

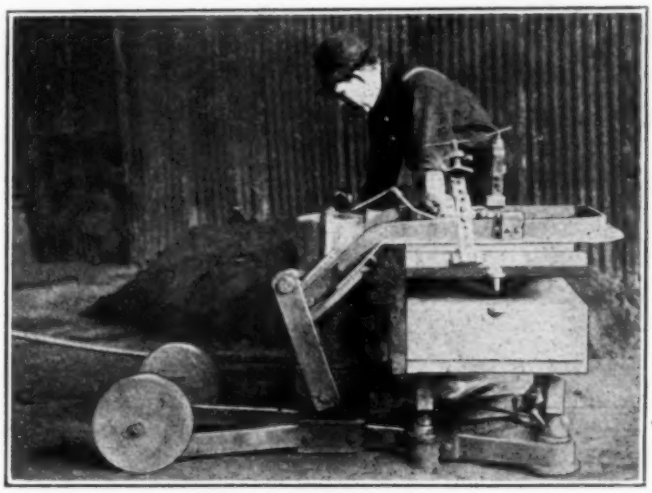
Rapid
MOLDING MACHINES
REG. U.S. PAT. OFF.

FEDERAL MALLEABLE COMPANY

WEST ALLIS, WIS.



Jolting the Mold



Drawing the Pattern

The Adams Pneumatic Jolting & Roll-Over Molding Machine

Four reasons why you should install it:

IT'S SIMPLE. No complicated parts to get out of order. All operations are handled in one large air cylinder, controlled by a simple air valve.

IT'S EASY TO OPERATE. It enables inexperienced help to put up good molds.

IT'S RAPID. Production is greatly increased over floor molding.

IT'S INEXPENSIVE. The first cost is low, and the machine soon pays for itself. It is economical in air consumption, being provided with a leather gasket to prevent leakage. All working parts are protected from the sand.

A Simple, Inexpensive Machine For Making Large Castings Economically

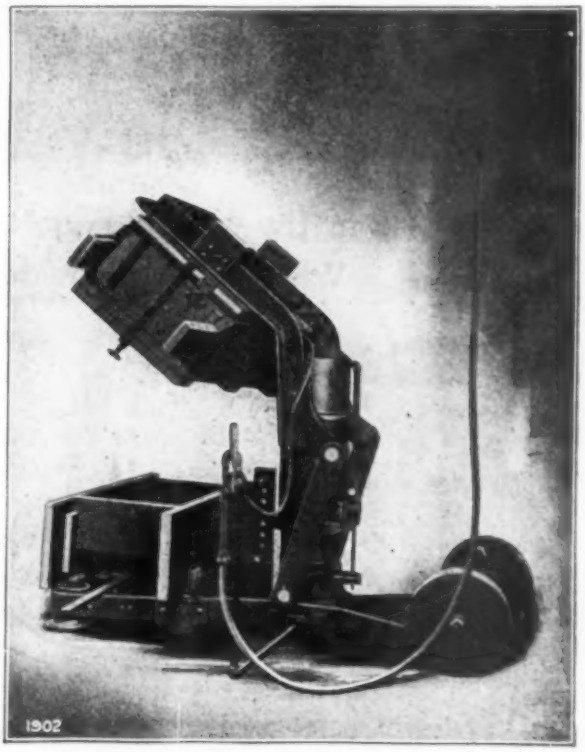
It jolts the mold, turns it over and draws the pattern straight, as slowly as desired, while same is being vibrated by an Adams Pneumatic Rapper. Built in three sizes, as follows:

No. 1—400 lbs. capacity; 8" draw.

Special No. 1—400 lbs. capacity; 14" draw.

No. 2—750 lbs. capacity; 12" draw.

Write for Catalogue No. 152

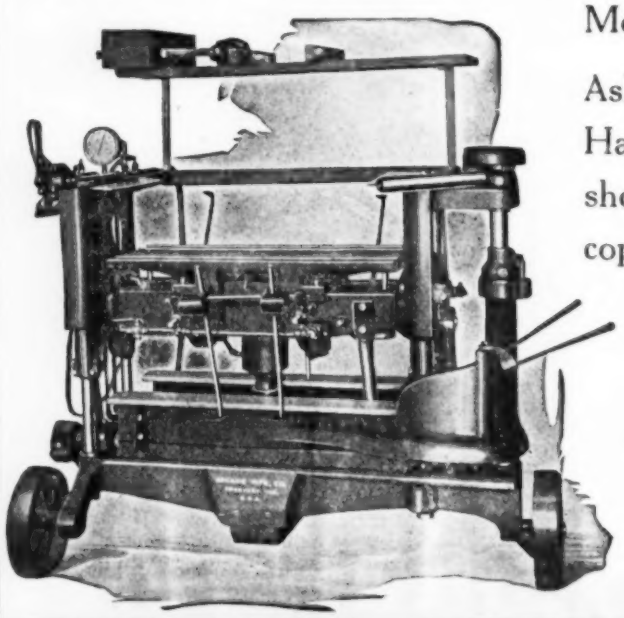


Rolling the Mold Over

The Adams Company Est. 1883 — 170 Foster Street, DUBUQUE, IOWA, U.S.A.

Modern Molding Machines at Work In Big New England Foundry

All Molds in the several floors above were put up on Modern Molding Machines. Where day after day production must be maintained the Modern will be found suited to the work.



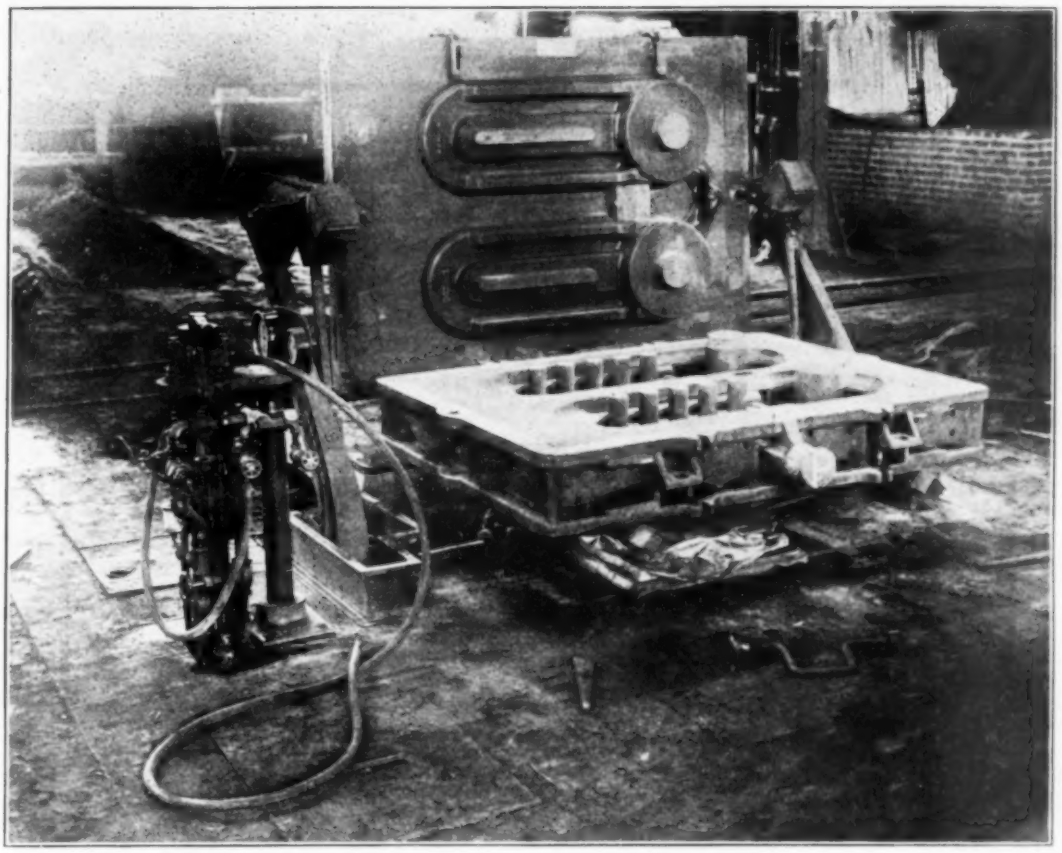
Ask for information on various styles of Hand and Power Modern — machine shown jolts, rolls over and squeezes both cope and drag at the same time and draws the pattern.

Arcade Mfg. Co.

Dept. D

Freeport, Ill.

If It's A Herman It's Worth Using. It Made Its Way by the Way it's Made



Doubling Production on Herman Machines

Herman Jar Independent Rollover and Pattern Drawing Machines are *your guarantee for speedy production* of work that is of a medium or larger nature.

With a "Herman", any mold can be jarred in less than a minute's time.

Write us the nature of your work and we shall send you full details regarding the size and type of Herman Molding Machine that will meet your requirements most profitably.

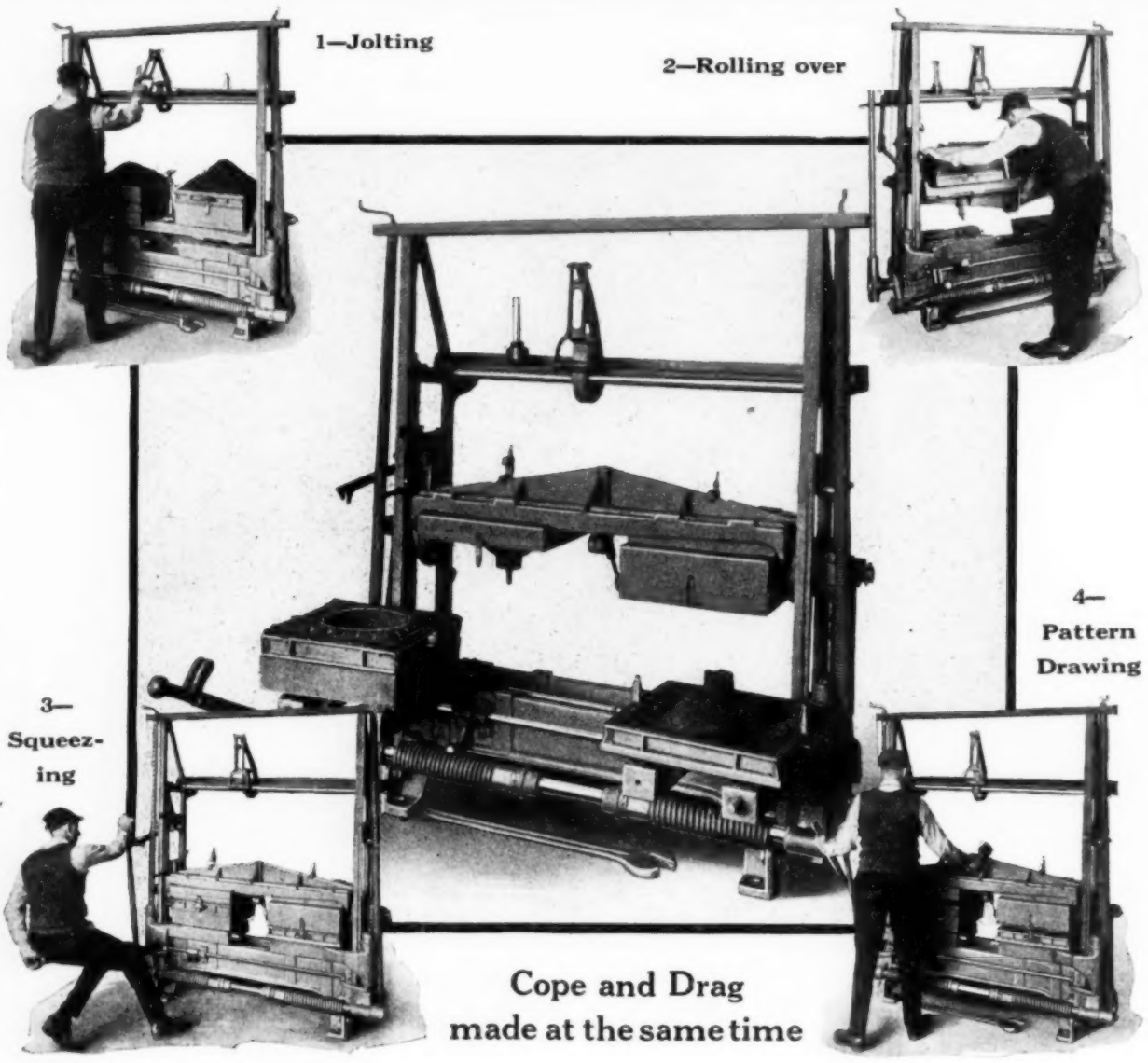
Herman Pneumatic Machine Company

GENERAL OFFICES Union Bank Building PITTSBURGH, PA.

MANUFACTURING PLANT: ZELIENOPLE, PENNSYLVANIA, U. S. A.

Foreign Works: Pneumatic Engineering Appliances Co., Ltd., 14 New Burlington St., London, S. W., England.

AMERICAN



Cope and Drag made at the same time

Uses no power or compressed air. It is entirely hand operated, making cope and drag together.

Does the entire job — jolt ramming, rolling over, squeezing, pattern drawing. Jolting packs sand firmly and evenly around the pattern. Squeezing eliminates need for butt ramming. Pattern drawing smooth and extremely accurate.

Skill not required. The operation is simple and easy. An unskilled man quickly learns to make perfect molds at profitable production rate.

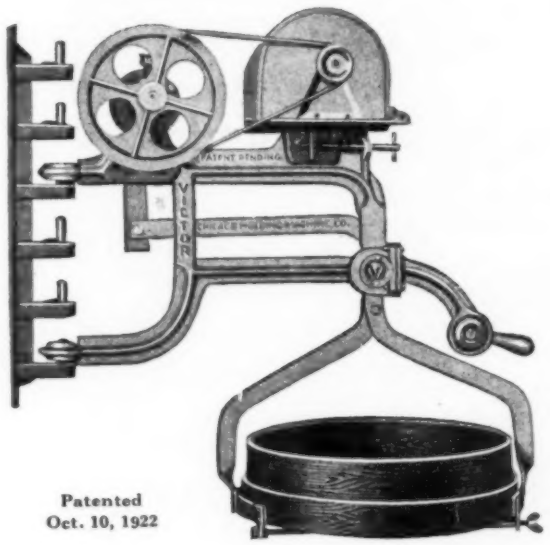
Inexpensive pattern equipment. Pattern matches made of American Pattern Mounting Compound do not shrink, and last for years.

A EQUIPMENT

THE AMERICAN FOUNDRY EQUIPMENT CO.
368 MADISON AVENUE, NEW YORK CITY
Boston Philadelphia York Pittsburgh Detroit Cleveland Chicago Waterloo

A EQUIPMENT

Masters of Your Sand Heaps!



Patented
Oct. 10, 1922

Victor Portable Riddle
(BRACKET TYPE)

This Riddle has many desirable features:

(1) It riddles sand faster than it can be shoveled.

(2) It can be carried easily about your foundry and attached to any wall or post where there is a bracket.

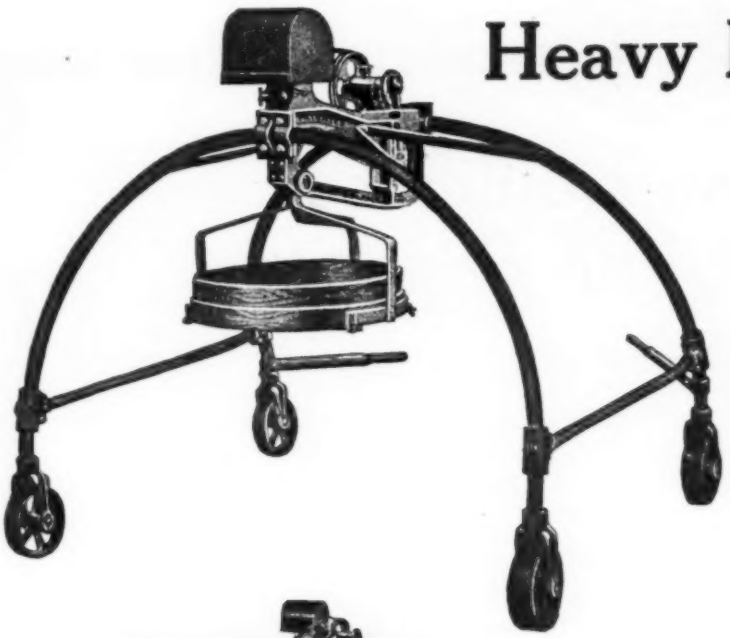
(3) Brackets are so constructed that Riddle can be operated at any desirable distance from floor.

(4) Has long life, because its construction eliminates crystallization of parts.

(5) Forks made to take 18" or 20" stock riddle.

(6) Furnished with Alternating or Direct Current Motor.

VICTOR EQUIPMENT
consists of many time and money saving devices for the foundry.
May we send you complete details?



Heavy Duty Sand Shaker

has the following features:

(1) There are 61 inches between wheels, for straddling sand heaps.

(2) It thoroughly mixes and cleans out the sand —being especially valuable in this respect for pulley and gear work.

(3) *Twelve yards of sand can be put through this machine in twenty-five minutes.*

(4) Any 24" stock riddle can be used and quickly removed from carrier.

(5) Equipped with ¼ H.P. Motor mounted in dust-proof box. Operated from ordinary lamp socket.

When replenishing a heap with new sand, it should be put through a Heavy Duty machine.

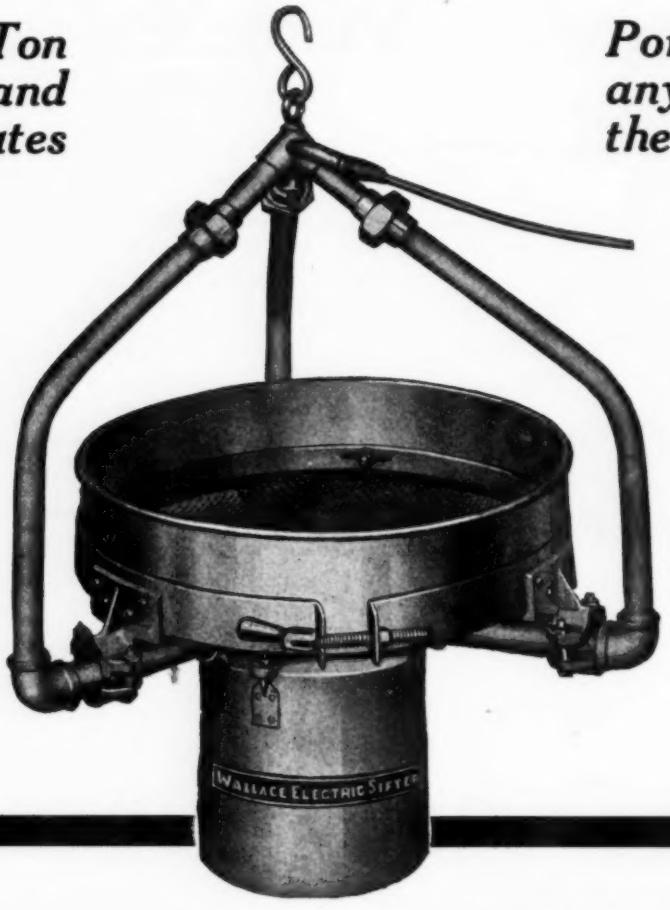
When treating a sand heap with bolted sea coal, a Heavy Duty Victor is needed to get it thoroughly tempered. This device is very rapid and efficient for mixing facing sand or core sand.

CHICAGO
MOLDING MACHINE CO.
NOT INCORPORATED
2028 North Major Ave. CHICAGO, ILL.

The Wallace Electric Sifter

Will Sift a Ton of Moist Sand in Four Minutes

Portable. Use it anywhere about the foundry



No loss of power through friction. Power is applied direct to the riddle.

Patent rotary eccentric motor housing imparts rapid vibratory motion.

Your Fastest Man Couldn't Keep It Working at Full Capacity

The Wallace Line of Bench Machines

Every item in the Wallace Line was designed to save handwork and wasted steps. In pattern shop or shipping room the items listed below would render you good service:

Wallace Bench Universal Saw
Wallace Bench Plain Saw
Wallace Bench 4" Planer
Wallace Bench 6" Jointer
Wallace Bench 16" Band Saw
Wallace Bench Glue Pot
Wallace Electric Sifter

It is folly indeed to sift by hand when the Wallace Electric Sifter is so much faster and enables the men to sift directly over the cores and flasks. Adjustable to any height and can be hung from any support. The extremely rapid motor runs from electric lighting circuit and all of the power is used to vibrate the riddle.

No exposed moving parts. Nothing to get out of order. Wallace Electric Sifters installed in your foundry will speed up work and will be found popular with your workmen.

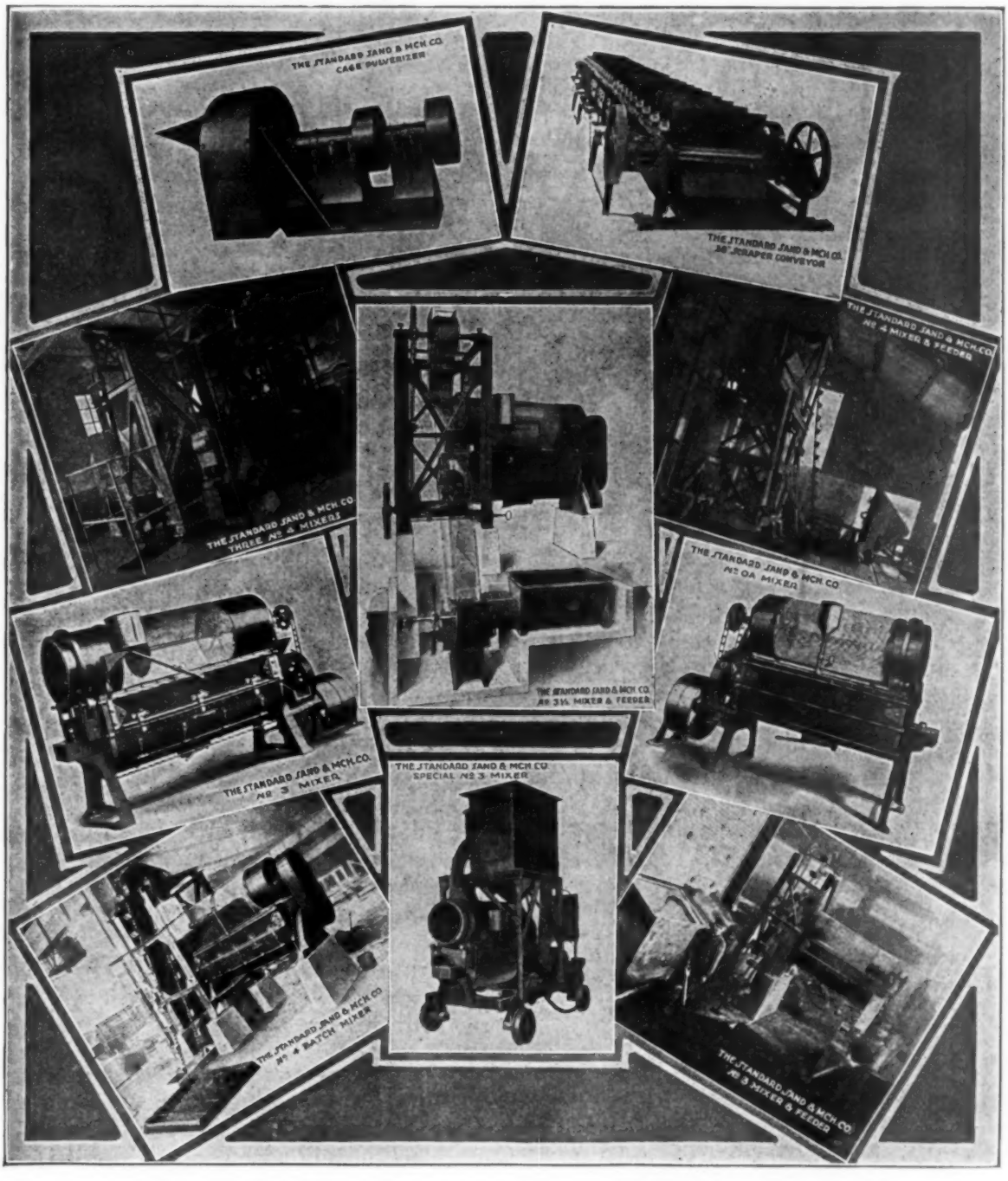
Send for Bulletin 220-U and prices

J. D. Wallace & Co.

1420 W. Jackson Blvd. Chicago, Ill.

Most All Machinery Dealers Handle the Wallace Line

THE STANDARD LINE


THE STANDARD SAND & MCH CO.
CAGE PULVERIZER
THE STANDARD SAND & MCH CO.
36" SCRAPER CONVEYOR
THE STANDARD SAND & MCH CO.
THREE No 4 MIXERS
THE STANDARD SAND & MCH CO.
No 4 MIXER & FEEDER
THE STANDARD SAND & MCH CO.
No 3½ MIXER & FEEDER
THE STANDARD SAND & MCH CO.
No OA MIXER
THE STANDARD SAND & MCH CO.
No 3 MIXER
THE STANDARD SAND & MCH CO.
SPECIAL No 3 MIXER
THE STANDARD SAND & MCH CO.
No 4 BATCH MIXER
THE STANDARD SAND & MCH CO.
No 3 MIXER & FEEDER

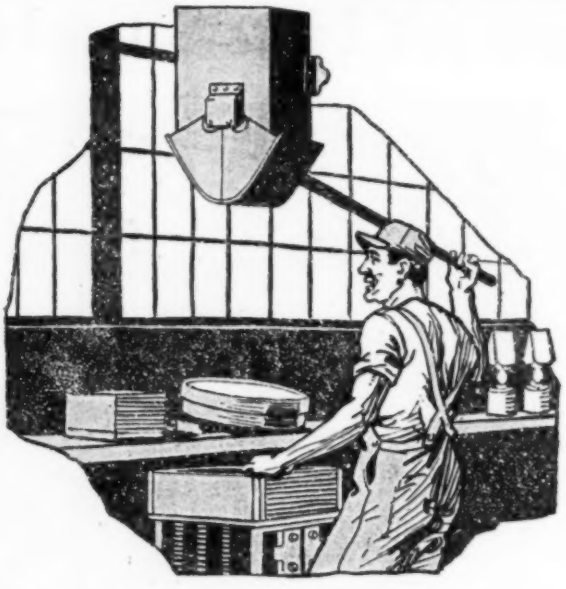
We have set the pace for twenty-two years building sand preparing machinery. Our machines are built up to quality and service and not down to the price.

To improve your product we manufacture a very wide range of core and facing sand preparing machinery which includes specialties to meet the need of almost every foundry, large or small.

Ask us about reclaiming your old sand

THE STANDARD SAND & MACHINE COMPANY

5151 St. Clair Ave., N. E.
CLEVELAND, O.



Just Compare These Two Pictures

AT the left you see a man whose job is molding but who really serves as both laborer and molder. Every pound of sand he puts into the flask is lifted with a shovel. That shoveling is mighty hard work. Towards the middle of the day even a husky molder gets tired. His skill and energy are dulled by back-breaking, strength-sapping labor. He begins to do less work. The quality of his molds begins to drop below standard.

Besides, just picture the foundry. Wherever there is a molder, you see a heap of sand and you find men going back and forth to keep enough sand in that heap. The floor space that should be used for molding is all cluttered up. There is unnecessary confusion. Under such conditions neither the man nor his equipment works at proper efficiency. Unnecessary labor goes into the finished casting. Costs are higher than they should be.

Now, consider the man at the right. All he does to fill the flask is pull a lever. Gravity brings the sand down from the overhead hopper. He wastes no energy shoveling. He uses all his energy and skill for molding. He is a molder in the real sense of the word. Working under such conditions, this man turns out more work. His molds are of uniformly high quality. The end of the day finds him much less tired and much more contented.

And equally important, there is no sand on the floor. It is all up overhead and out of the way. The molding floor is clear and orderly. More molders can work on such a floor. More work can be turned out. Both men and machines work at maximum efficiency. No unnecessary labor goes into the finished casting. Here, costs are low. Business is easier to get. Profits are greater.

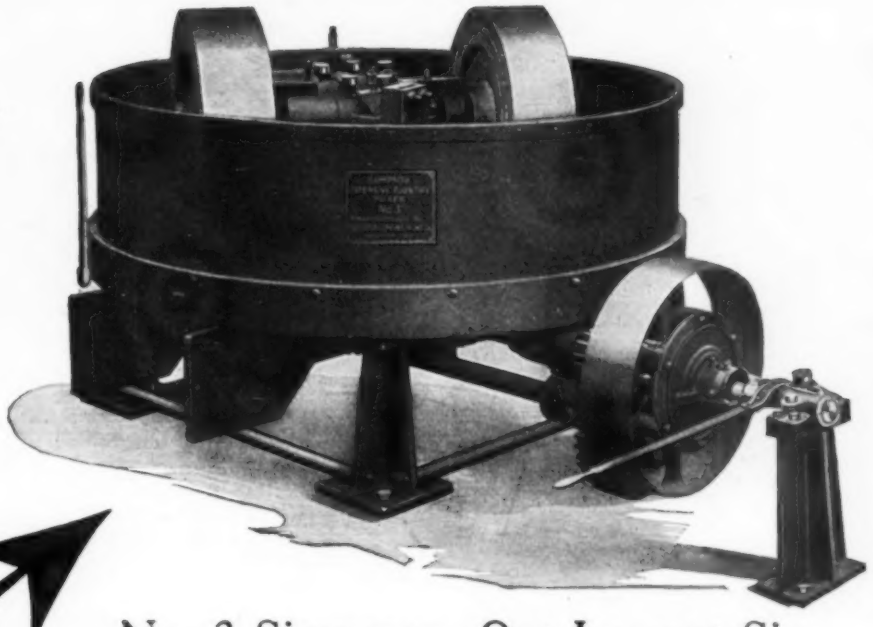
All we have done above is sketch the fundamental advantages of hanging the sand up in the air. You will want to know how this idea is carried out in practice, so we have taken photographs in ten typical foundries throughout the country and put them into a concise booklet prepared particularly for men like you. You can get your copy by writing and asking for Bulletin 49. We suggest merely that you write now while you think of it.

THE C. O. BARTLETT & SNOW COMPANY

MAIN OFFICE AND WORKS: CLEVELAND, OHIO

SIMPSON
Intensive Foundry Mixer

Economical
and
Efficient
for
All kinds of
Sand
Mixtures



No. 3 Simpson—Our Largest Size

holds an average batch of 2000 lbs. As far as capacity is concerned, there is no other mixer on the market, so far as we know, that can compare with the daily tonnage of this size "SIMPSON".

The SIMPSON MIXER will also prepare daubing for lining furnaces, ovens, cupolas, etc.

It is strong and sturdy and requires the minimum operating and upkeep expense. Automatic discharge.

May we send latest catalog? Four Sizes

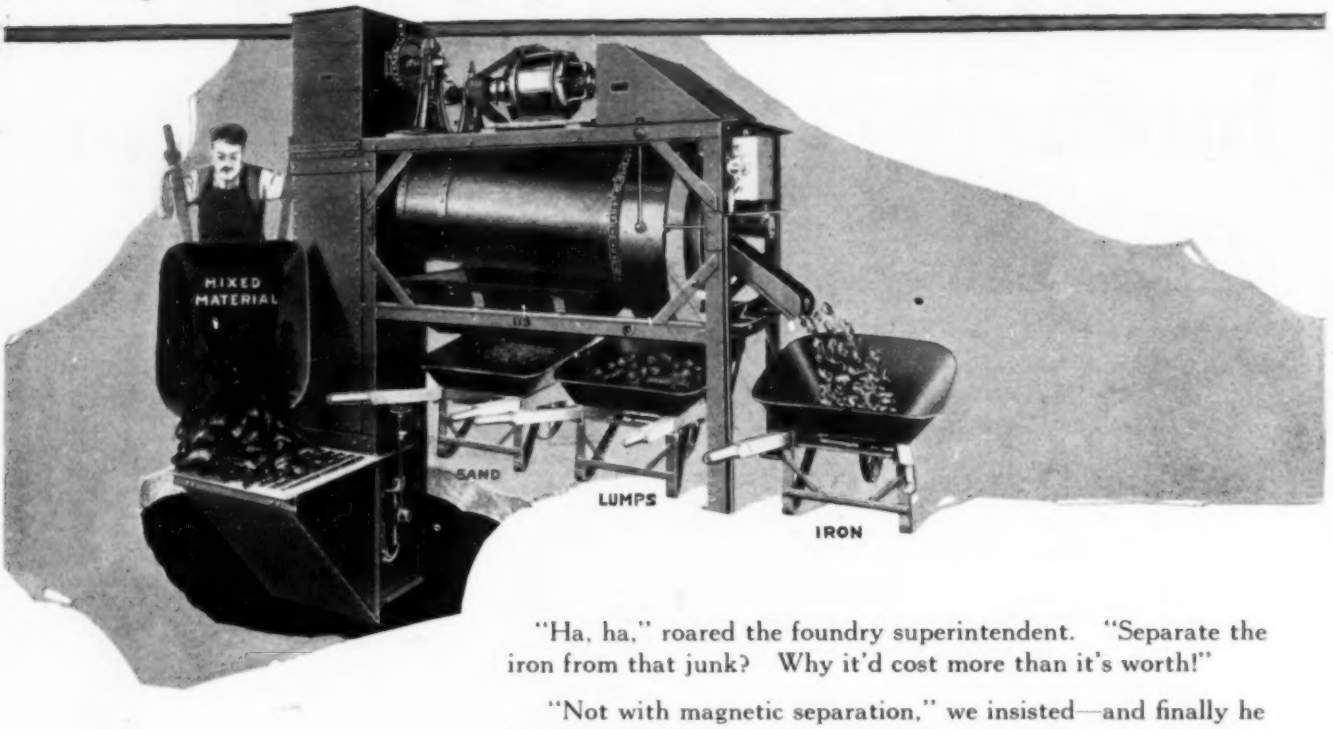
"THE PRODUCT OF A PRACTICAL FOUNDRYMAN"

National Engineering Co.

Machinery Hall Bldg. **549 W. Washington St.**

CHICAGO, ILL.

They found a fortune in the junk pile!



"Ha, ha," roared the foundry superintendent. "Separate the iron from that junk? Why it'd cost more than it's worth!"

"Not with magnetic separation," we insisted—and finally he installed a **High Duty** Magnetic Separator. Four months later, this is what he said (and you can have his name on request):

"The separator paid for itself in three months. Why, I had no idea there was such a high percentage of iron in that refuse. We make a big profit on that machine every day. It saves nails, core wires and rods that we can use again—the workmen prefer them to new material.

"Now we're using it to recover iron from the cupola drop and slag—and some other new use is discovered every day."

Are you reclaiming all iron in your foundry—or do a good share of your profits go into the waste heap? **High Duty** Magnetic Separators don't really **cost** anything—they **save** money! Write for **free,** informative booklet telling how to reclaim "waste material."

Magnetic Manufacturing Co.
208 23rd Ave. Milwaukee, Wis.

BRANCHES: New York, Chicago, Detroit, Philadelphia, Pittsburgh, Cleveland, Cincinnati, St. Louis, San Francisco, Los Angeles, Salt Lake City, Portland, Ore. See 'phone directory.

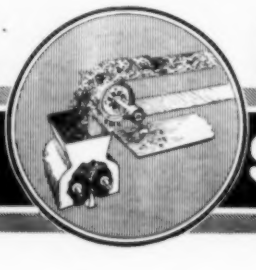
Put it up to men who know your problems. The officials of the Magnetic Manufacturing Co. are pioneers in this field—their machines have many exclusive features—the installation cost is less.

FREE LABORATORY SERVICE

Special separating problems solved for you in our own laboratories. Write at once for full information.

FREE—Illustrated handbook showing how fortunes are made from junk piles—full of valuable information for every foundry official—sent on request. Write for your copy now!

HIGH DUTY



Magnetic Separators

IT IS THE SPEED OF THE CUT THAT AMAZES THEM

HERE is an Aloxite Wheel specially developed for the purpose of rough grinding steel castings, manganese, malleables and for general steel work. It is a coarse grit, heavy duty wheel that is made to lower grinding costs by producing greater tonnage in the grinding room.

In one plant, for instance, on grinding steel castings, this wheel did 25% more work and lasted 42½ hours longer than the best competing wheel.

This wheel cuts faster and produces more because of its open porous structure and because of the superior abrasive ability of the hard, sharp, tough Aloxite Grain.

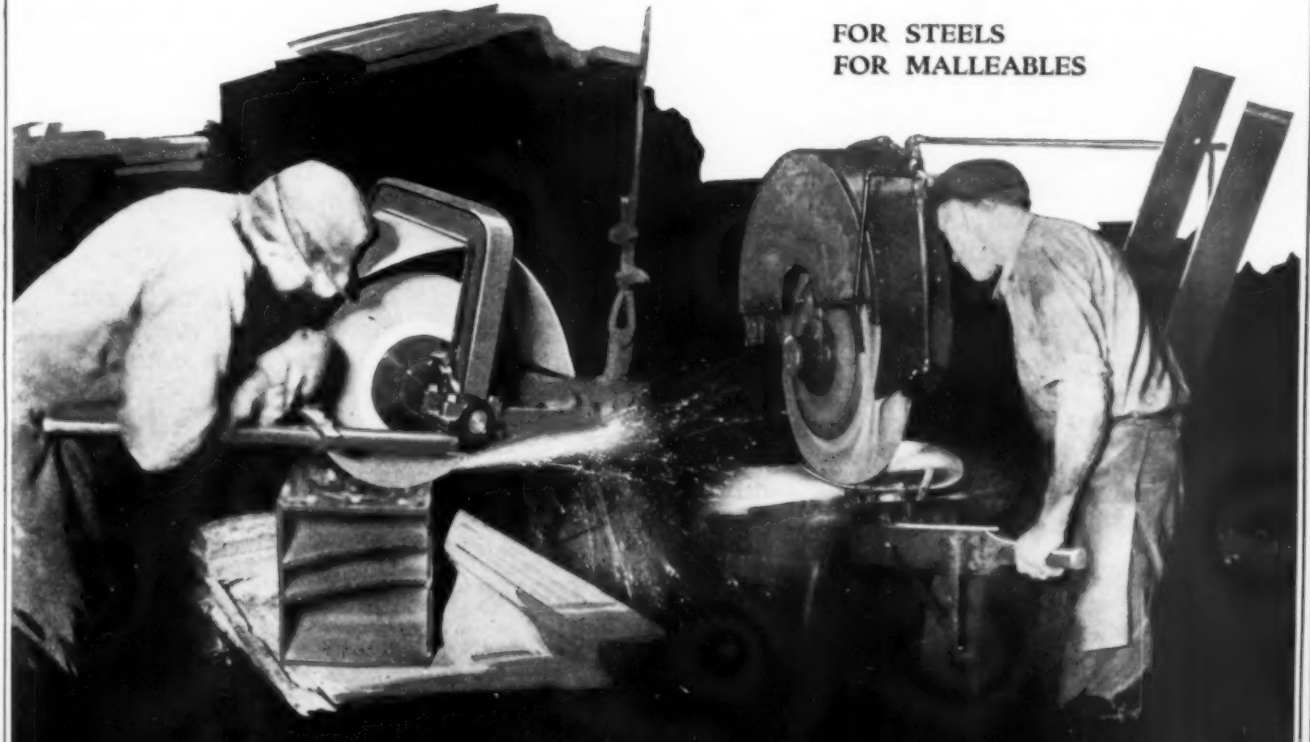
Every grain gets a real chance to cut because it has a definite clearance. The wheel doesn't fill and requires but little dressing.

It is a durable wheel that shows long enough life to be economical—yet it has the astonishing speed of cut.

Our Sales Service Department will gladly see to it that you get the right wheel in the right place.

ALOXITE GRINDING WHEELS

FOR STEELS
FOR MALLEABLES



The Carborundum Company, Niagara Falls, N. Y. U.S.A.

New York, Boston, Philadelphia, Chicago, Cleveland, Cincinnati, Milwaukee, Pittsburgh, Detroit, Grand Rapids

The Story of "Flint Shot" Sand Blast Abrasive

For the benefit of newcomers in the sand blasting field (old hands know all about it) let us enumerate briefly some of the outstanding advantages of

FLINT SHOT
TRADE MARK - REGISTERED

1. The pearl-like granules of pure flint are exceedingly hard and free from the lines of cleavage that cause ordinary sand-grains to split or splinter. This accounts for the long-life of Flint Shot under conditions that destroy ordinary sand.
2. Our process of separating these "shot" from our deposit of St. Peters Rock, and washing, drying and screening, insures a product that is remarkably uniform in size, contour and hardness. That means uniformity in work done.
3. The action of Flint Shot, when driven by the air against the metal to be cleaned, is *peening*, rather than cutting, scoring or scratching. *Result:* A beautiful surface, ideal for plating, painting, enameling, or other finish.
4. At the same time, contrary to the prejudice once held by advocates of "sharp" sand, FLINT SHOT does *faster* work in removing burnt sand from coarse castings than any angular abrasive—mineral or metal.
5. The smooth clean round contour of Flint Shot makes it a free-running abrasive—easy on nozzles, piping and connections.
6. Being mineral, there is nothing about Flint Shot to rust, either in storage or in piping. Remember, there is always moisture present where air is compressed.
7. Flint Shot is shipped bone-dry, in paper-lined box cars.

Cheapest in the Long Run

Because it lasts longer than any other mineral abrasive; does so much more work per ton, and per unit of air, power and labor.

Working sample Free

UNITED STATES SILICA CO.
122 South Michigan Ave. Chicago

To American Foundrymen

Holiday Greetings from the Sly Clan:

Here's to you all
Where'er you're from
May the best day you ever had
Be worse than your best to come

THE SLY LINE

For a prosperous 1923

Tumbling Mills
Cinder Mills
Resin Mills
Core Ovens
Core Cars
Cupolas

Slyblast Mills
Slyblast Rooms
Slyblast Cabinets
Slyblast Tables
Dust Arresters
Exhaust Fans

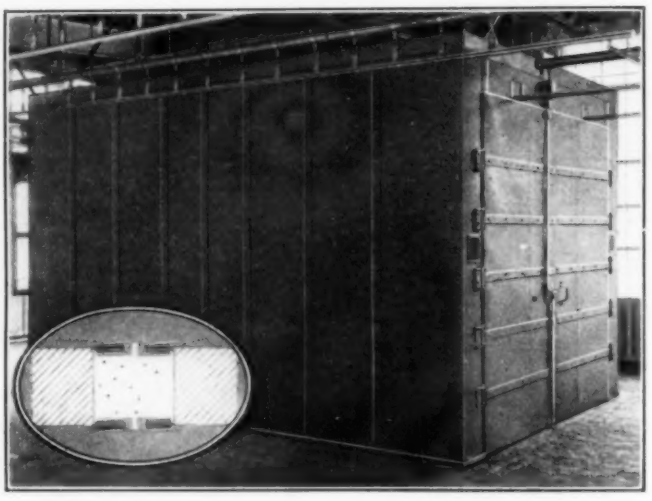
THE W. W. SLY MFG. CO.
CLEVELAND, OHIO
OFFICES IN ALL PRINCIPAL CITIES

An Oven that turned Savings Bank

*Pittsburgh manufacturer makes $50.00 saving each month on a single Swartwout oven.**

AT THAT rate—$600 a year—it won't take this company long to pay for the Swartwout installation and pile up a nice saving besides.

What's more, the erection cost of the oven was almost nothing. Swartwout construction is so simple that green men put it up in a very short time. The size was 9 feet wide, 10 feet deep and 8 feet high.



And best of all—this Swartwout Oven doubled their core production the day it was installed and has been keeping up the pace ever since.

Swartwout engineers have a world of experience to draw from when investigating oven problems, for they have placed Swartwout Ovens in hundreds of plants of all kinds. Nor are they limited to any type of oven or kind of fuel. Swartwout makes all types for any kind of fuel.

The class of work, the fuel available and the production required is their guide. Swartwout recommendations based upon these all important factors, invariably result in savings, as large or larger than the one described above.

A careful survey of your present oven equipment, a check on its efficiency and a recommendation for its improvement will be furnished gladly without obligation if you but say the word. Similar work for others has opened their eyes to unnecessary loss. It may do the same for you.

Meanwhile you will want the Swartwout "Book of Industrial Ovens" which we will send you upon request together with a very practical treatise on ovens recently presented to A. F. A. members. Address the Swartwout Industrial Division, The Ohio Body & Blower Company, 9203 Detroit Ave., Cleveland, Ohio, U. S. A.

**The name of this manufacturer and a detailed story of this Swartwout money-saving installation will be furnished on request to any manufacturer using industrial ovens.*

Swartwout
Industrial Ovens

Any size, any fuel—maximum efficiency for every drying and baking purpose

F. A. COLEMAN OVENS

By The Name You Shall Know Them

Battery of Rolling Drawer Ovens just completed at Dick Brothers, Inc., Reading, Pa.

Any Type Oven

They are the best the market affords, because they are the result of 17 years continuous experience in the design and manufacture of Ovens and of constant study for the purpose of improving those things which are capable of being improved.

Any Kind of Fuel

Write for full particulars covering the many new exclusive features in F. A. COLEMAN OVENS.

Complete Core Room Equipment
Ladles and Shanks
Simpson Intensive Foundry Mixers
Lift Trucks
MAGNETIC SEPARATORS
ANYTHING IN FOUNDRY EQUIPMENT

F.A.C. EQUIPMENT FOR FOUNDRIES

THE F. A. COLEMAN CO.

MANUFACTURERS—ENGINEERS

Foundry Equipment,
Complete Core Room Equipment,
Shanks, Tongs, Ladles, Magnetic Separators,
Sand Blast Equipment, Trolley Systems, Lift Trucks,
Simpson Intensive Foundry Mixers

Office and Works: 6539-43 Metta Ave. CLEVELAND, OHIO

Are You Looking Ahead?

Before you start searching for that job, a little thought about what the Employer is thinking about would help a great deal.

The best man he can get for his money is not altogether what he is seeking. His big idea is to fill the job with such a man that, if it is ever going to be vacant again, promotion will be the reason.

It is a rank waste of time to place a man in a "blind alley" job when he is looking for a future.

Business in the metalworking trades is rapidly improving and the executives who read THE FOUNDRY have begun to seek men who look ahead of the particular job they are qualified to fill.

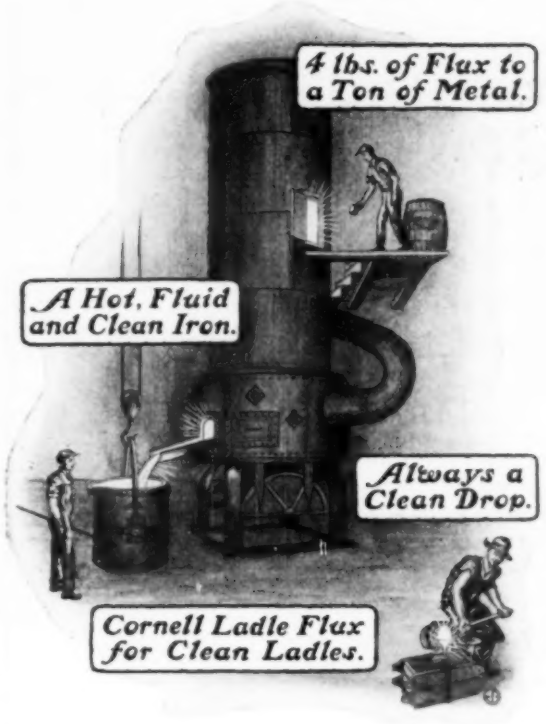
The Help and Positions Wanted columns of THE FOUNDRY are continually referred to by Employers when they have vacancies, for they know the type of men that can be reached there.

If you are seeking a position we believe the time is now propitious to get before the Employers who want the kind of experience and "get there" ability you have.

Your ad in the "Positions Wanted" columns of the Employment section of the next two or three issues will help.

See the Help and Positions Wanted ads on pages 86-87

674



A cupola using "Famous Cornell" Cupola Flux

Prevent Foundry Troubles and You won't have to stop them!

The "FAMOUS CORNELL" Iron Cupola FLUXES will prevent such foundry troubles as *Dull Iron*, Hang-Ups, Porous Castings, Warped Castings, Poor Pig, High Sulphur, Coke; also many other difficulties that almost daily cause the average foundryman untold worry and expense.

Whether you are making gray iron, steel, brass or aluminum castings, let us show you the best and least expensive method—no expense to you. We prepare a special flux for each demand, and we don't miss any.

We have today on our books **937** continual carload users of our *"Famous Cornell" Cupola Flux*. Also we have several thousand additional constant users who require from 1 to 13 barrels at a time. **83%** *Of brass foundries use our brass flux.*

The largest railroad in Canada writes as follows: "We save $12.00 a day in coke, by using your 'FAMOUS CORNELL IRON CUPOLA FLUX.'"

(Name furnished upon request)

A very large foundry in Cleveland says, "Without your Ladle Flux, we had dull, dirty Iron and a stuck up Ladle", "We would not be without your flux now."

(Name furnished upon request)

The biggest foundry in the world, in Detroit, says, "Your fluxes are a God's blessing to foundry practice, and we use them daily in our seventy-two cupolas."

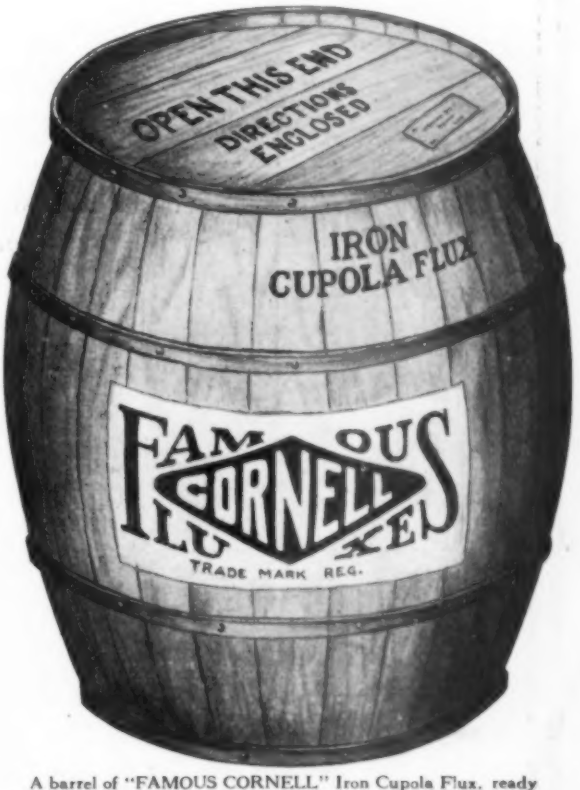
Phone, write or wire today for at least a trial order.

We can easily convince you that it is far better and cheaper to use our *"Famous Cornell Iron Cupola Flux"* than limestone.

Then let us convince you.

Never less than a single barrel shipped on trial as it requires that much for a trial test, but the first barrel is always shipped on approval.

"NO PAY IF NOT SATISFACTORY"



A barrel of "FAMOUS CORNELL" Iron Cupola Flux, ready for shipment. Each barrel weighs approximately 800 pounds.

The Cleveland Flux Company

1023 Front Ave. CLEVELAND, OHIO Telephone Main 6063

Distributors:

Frederic B. Stevens, Detroit, for State Michigan
Frederic B. Stevens, Erie, for Erie and Buffalo
The Hill & Griffith Co., Cincinnati, for Southern Ohio
The Hoosier Supply Co., Indianapolis, for State of Indiana.
L. W. Anthony & Co., 232 Mason Bldg., Los Angeles, for California
The Dominion Foundry Supply Co., Ltd., Montreal and Toronto, for the Dominion of Canada.

Our "Famous Cornell Fluxes" manufactured in your Dominion for your convenience. They are made in Canada, with Canadian Products, but same fluxes exactly.

TWO-SIDED OR FOUR-SIDED--------I BUSINESS VISION-?-

There's no position into which you can maneuver yourself where you can see more than two sides of a building at one time.

The only way you can see all four sides at once is to station some one else over on the other side in cooperation and view the other two sides through his eyes.

By using IRON TRADE REVIEW as your assistant in this way, you can see all four sides of business at once, every week—especially features that affect you as a user of iron and steel.

By means of its large editorial and news-gathering staff both here and abroad, IRON TRADE REVIEW is argus-eyed and can see, and interpret, the entire arena of business activity and development in this country and Europe.

Let IRON TRADE REVIEW help you see "the other two sides of business", too. You really can't afford to be without it.

The cost is nominal—only $6.00 a year or about 12c a week—see enclosed folder.

IRON TRADE REVIEW

—a Penton Publication

Penton Bldg., Chester Ave. & East 12th St.
CLEVELAND

IRON TRADE REVIEW

Please send Sample Copy of recent issue of **IRON TRADE REVIEW** containing "The Business Trend" Section to

Name .....

Address .....

City ..... State .....

MAKING GOOD STEEL BETTER

No. 26

The Regular Use of
a few pounds
of

FERRO CARBON-TITANIUM

in your steel as
tapped from your
Furnace will result in

MAKING GOOD STEEL BETTER

by
thoroughly deoxidizing and cleansing
the metal.

This means—

For You, A higher yield of good castings.

For your Customers, Lower losses in machining and better service in operation.

The Titanium Alloy Mfg. Co.

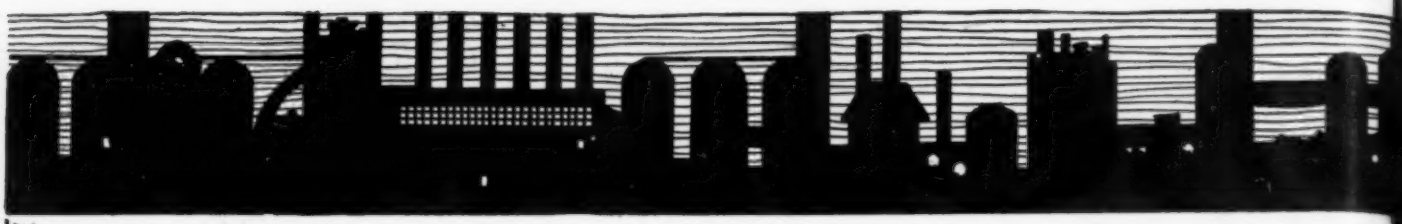
General Office and Works: NIAGARA FALLS, N. Y.

New York Office
94 Fulton St.

Pittsburgh Office
Oliver Bldg.

Chicago Office
Peoples Gas Bldg.

Agents for Great Britain and Europe: T. Rowlands & Co., Ltd., Sheffield, England.



The Year Boo

IRON TRADE REVIEW ANN

JANUAR

Some of the leading featu

A tracing by graphs of the leading fundamental business factors of the year in comparison with previous years, affording a complete picture of basic commercial stability and prospects.

The business year from a legislative and governmental standpoint prepared by the Washington staff correspondent of IRON TRADE REVIEW and based upon an appreciative survey of the nation's economic and political thought as revealed at the capital.

The technical progress of the iron and steel and metallurgical industries reviewed and appraised by foremost engineers and authorities in various fields.

Further development of the analysis of steel consumption of the United States by product and occupation, originated and carried on exclusively by IRON TRADE REVIEW.

The new iron and steel works construction of the year classified and interpreted as to underlying

The Authority of Industry—

k of Industry

UAL STATISTICAL NUMBER

Y 4, 1923

res this issue will contain:

tendencies; a similar treatment of general industrial construction.

The labor movements of 1922 and their probable future significance.

The year on the Lake Superior iron ore ranges with complete statistics of production and shipments.

The trend of international competition in iron and steel and the prospects for the maintenance of the present position of the United States in export trade.

A complete market record, statistical and historical for the year and for a term of years, of various leading products of iron and steel. These reviews and data cover equally the year's conditions in the United States and in all the other leading iron and steel countries of the world.

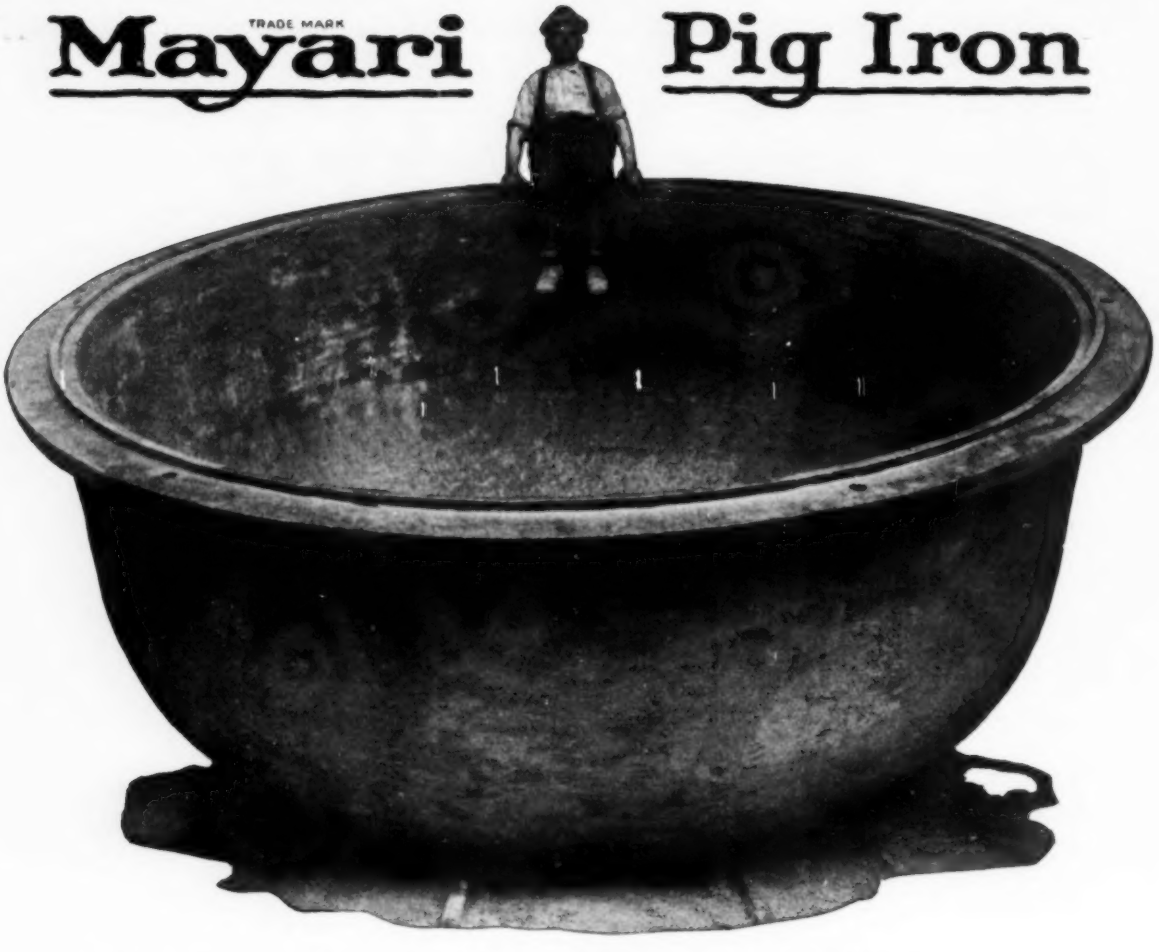
World's iron and steel production in 1922, exclusively compiled by IRON TRADE REVIEW.

And various other major articles of definite commercial value to every reader.

National and International

BETHLEHEM

TRADE MARK Mayari Pig Iron



Cast Iron Caustic Pot, Weight 36,000 Pounds

Mayari Iron added to the mixture in the cupola has repeatedly proven its value in the production of high grade castings for many purposes.

In the manufacture of the caustic pot here shown, an addition of Mayari Iron enabled the foundry to produce an extremely large casting which showed solid metal throughout, and was absolutely free from pin holes.

Take up your better-castings problems with our metallurgists.

"Mayari Pig Iron" Booklet on Request

BETHLEHEM STEEL COMPANY

General Offices: BETHLEHEM, PA.

Sales Offices:

New York Boston Philadelphia Baltimore Washington Atlanta Pit
Buffalo Cleveland Detroit Chicago St. Louis San Francisco

RESULTS—

From the use of pulverized coal as fuel

"Rayco" equipped furnaces in a large malleable iron plant.
Rayco System also used under boilers at same plant.

Through careful research work we have been able to compile a data sheet showing in a specific, concise and definite manner the economies, operating and production advantages obtained in a number of cases where pulverized coal has been used for industrial furnaces and under boilers.

This data sheet is included in our catalog, of which we will gladly send copy to anyone interested.

The catalog will also make clear to you the comprehensive, complete and responsible engineering, manufacturing and installation service rendered in connection with

"RAYCO" Pulverized Coal Systems

This service goes far beyond problems involved in the preparation, storage and burning of the fuel. It comprehends all related problems of operation and production.

Ask for the catalog and get the whole story.
It may prove tremendously worth while to you.

THE RAYMOND BROS. ENGINEERING CO.

1307 North Branch Street, Chicago

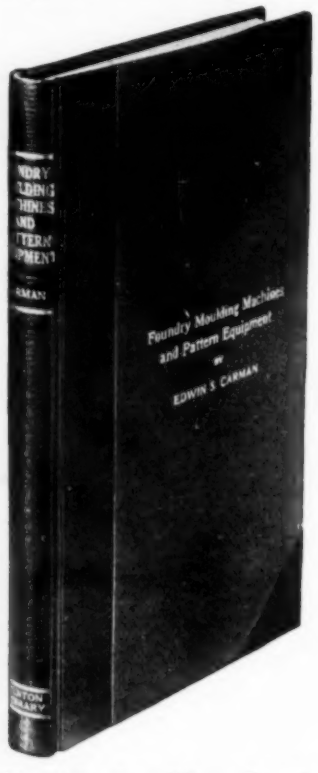
New York **Los Angeles** **Paris, France** **Bedford, England**

The first and only book on moulding machines

"Foundry Moulding Machines and Pattern Equipment"

By E. S. Carman

A 225-page book full of data on Foundry Moulding Machines most of which has never been published before. Tells you just what you want to know about the latest practice in—



General Moulding Principles
The Theory of Jolt Ramming
Roll Over Jolt Moulding Machines
Roll Over Jolt Moulding Machines for Large Size Moulds
Roll Over Jolt Machines for Medium Size Moulds
Roll Over Jolt Machines for Small Size Moulds
Jolt Moulding Machines in Brass and Aluminum Foundries
Plain Jolt Moulding Machines
Air Operated Squeezer Machines
Jolt Stripper Moulding Machines

Complete Information On—

Pattern Equipment
Flask Equipment
Machine Moulded Cores
Foundations for Jolt Ramming Moulding Machines

Invaluable to the foundryman, who wants to know just what type of moulding machines and what pattern and flask equipment is best for his use.

PRICE POSTPAID

$5.00 in North America — 25s. in all other countries

USE THIS COUPON

THE PENTON PUBLISHING CO.
Book Department
PENTON BLDG. CLEVELAND, O.

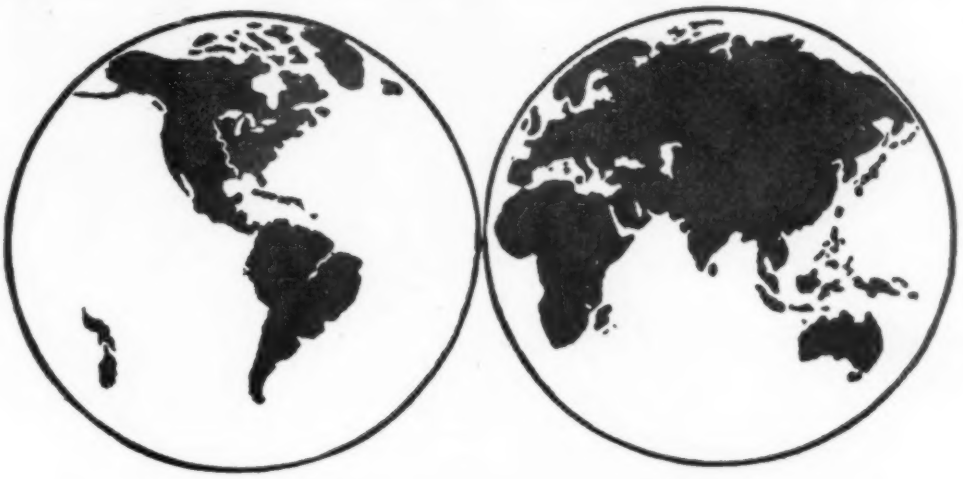
Date.....

Enclosed find {$5.00 / 25s.} for which please send me, all charges prepaid, one copy of "*Foundry Moulding Machines and Pattern Equipment*," by E. S. Carman.

Name.....

Address.....

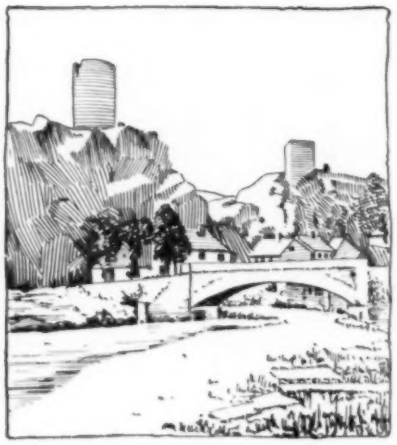
121 IFD



Around the world with THE FOUNDRY

Little journeys to the homes of our readers

LUXEMBURG



AMONG all the upheavals, social, religious, national and political that have convulsed Europe and changed the map so many times during the past 700 years, the little Grand Duchy has remained intact, serene and peaceful as the many streams that flow into the Moselle. A hundred years ago she saw Napoleon's apparently invincible army stream past her southern frontier in a vainglorious expedition into Russia and she saw remnants of the same proud army creep back the following year after pestilence, famine, snow and the wild blasts of winter had taken their toll and strewn the road to Moscow with the bones of brave men who blindly, confidingly and enthusiastically, supported the fortunes of the man of destiny.

In 1914, gray-coated German legions slid past her northern frontier in their initial dash across Belgium and for four long years as the fortunes of war ebbed and flowed, she heard the roar of big guns day and night and saw ghastly, grisly war stalking boldly and brazenly through the territory north, south and east filling millions of graves with young men, literally the salt of the earth.

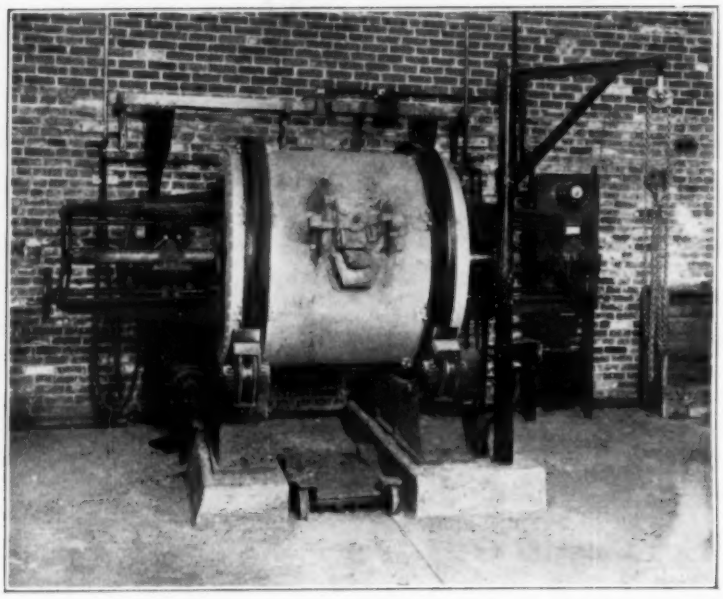
Outside of Lorraine, once more after 50 years recognized as French territory, Luxemburg includes within its borders the greatest iron and coal deposits in Europe. Naturally in a country where these resources are developed extensively the foundry industry is important and just as naturally THE FOUNDRY is regarded as a standard authority in two of the principal casting plants.

In gentle days of peace or during the roaring red days of war

"Wherever metals are cast, you'll find THE FOUNDRY"

(This advertisement is No. 48 of a series)

DETROIT INSURANCE



Removes the Melting Guess-Work

DETROIT ELECTRIC FURNACES

ARE MELTING MORE BRASS FOR AMERICAN FOUNDRIES THAN ALL OTHER MAKES OF ELECTRIC BRASS MELTING FURNACES COMBINED.

HERE'S THE REASON

A DETROIT representative will tell you EXACTLY what your costs will be with DETROIT equipment in your plant.

We Definitely Guarantee These Costs.

Let Us Tell You the Facts of DETROIT SERVICE

DETROIT ELECTRIC FURNACE CO.

645 BOOK BUILDING DETROIT, MICH.

Hanna Trolleys -Hyatt Equipped- Move Loads Economically

All I-beam trolleys built by the Hanna Engineering Works have Hyatt roller bearings as standard parts.

By the combination of all-steel bearings with their all-steel construction they produce an easy running, load moving unit that is economical because it maintains its effectiveness through years of hardest service without the necessity of bearing adjustment or replacement.

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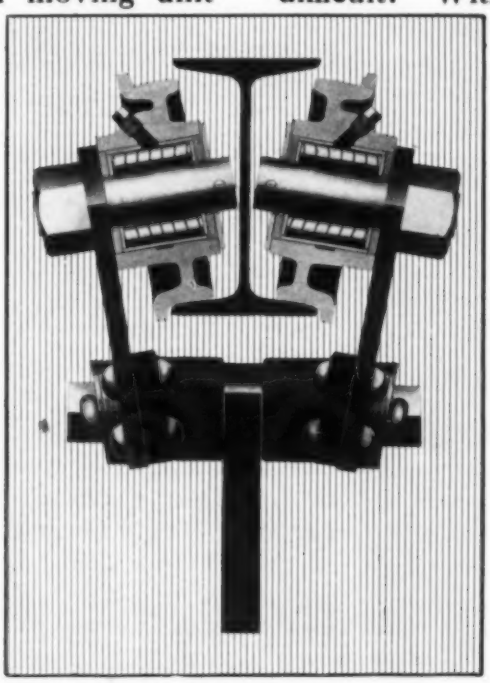

Hyatt bearings are standard equipment on all trolleys built by the Hanna Engineering Works, Chicago, Ill.

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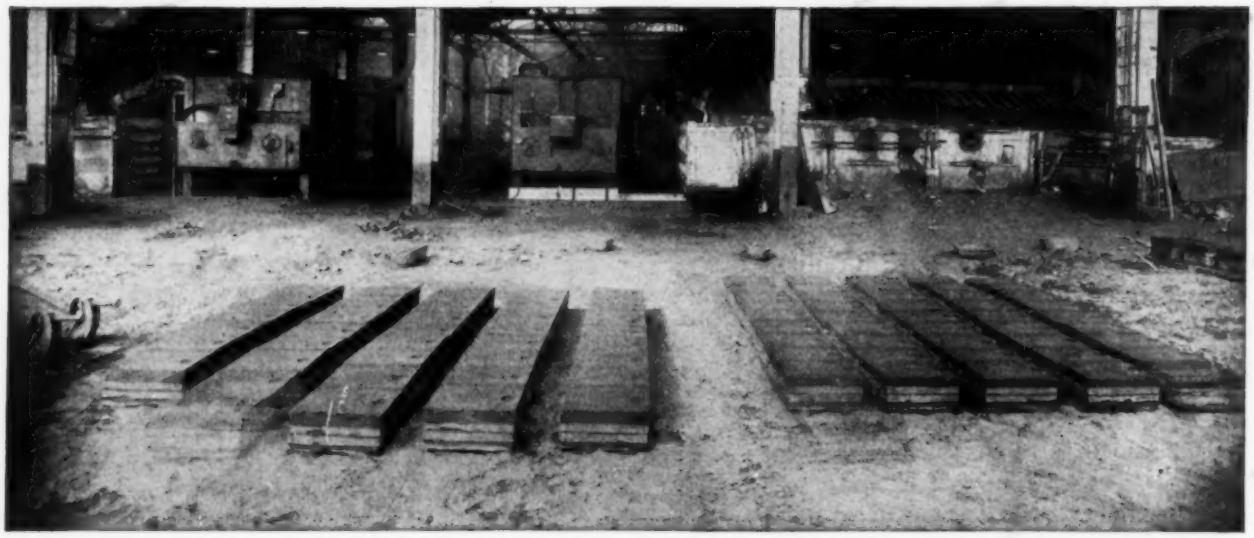

Cut G-4. *Grindle Equipment applied to two 25-ton reverberatory furnaces, showing equipment in pit, top of hopper 8 feet from floor; this allows space for operation of crane overhead. Five furnaces are now operating with Grindle equipment, melting 250 tons per day. Each furnace is capable of melting 70 tons per day (40 tons first heat, 30 tons second heat—second heat melted in 6 hours). When fired by hand, the maximum melt was 20 tons per heat.*

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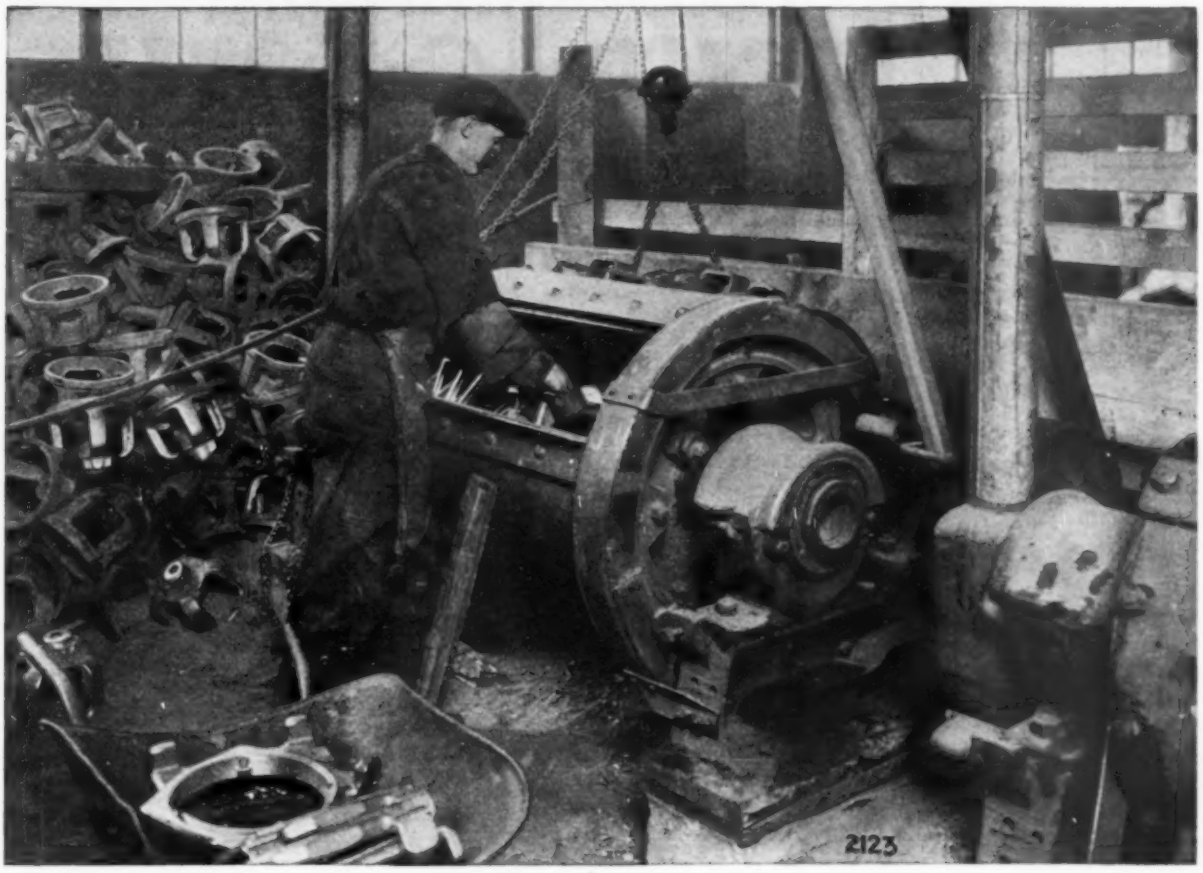
See Page 55



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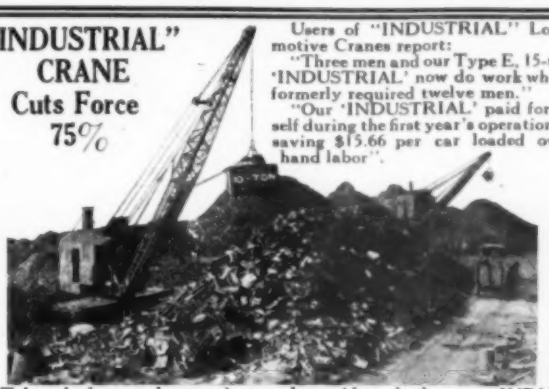

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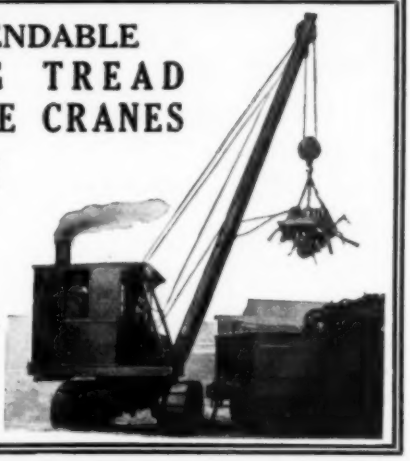

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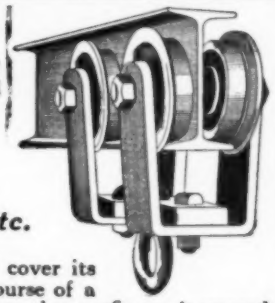

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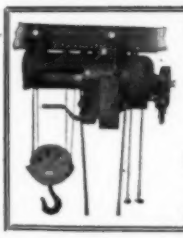

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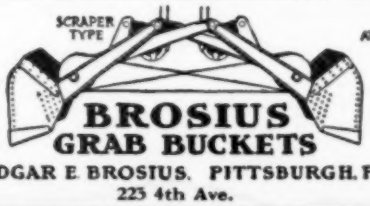

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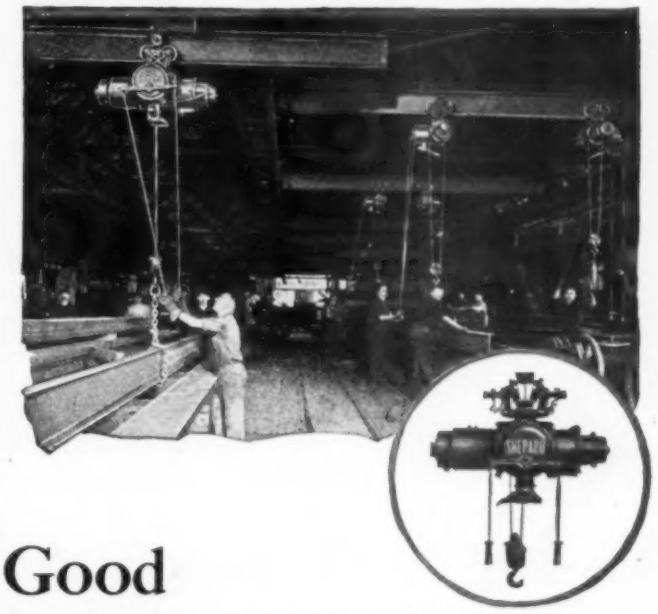

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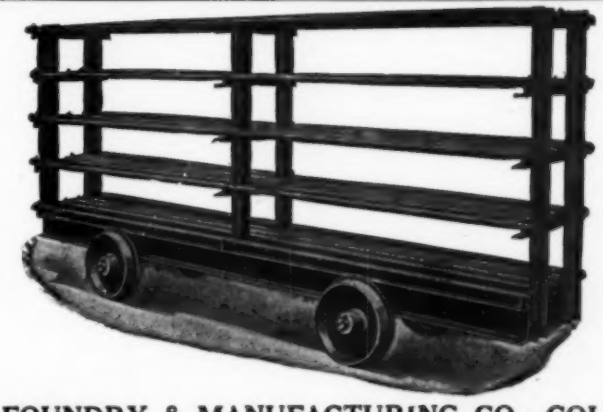

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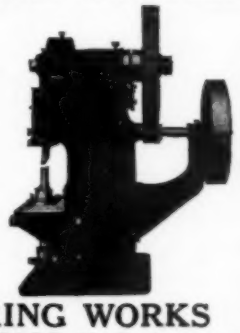

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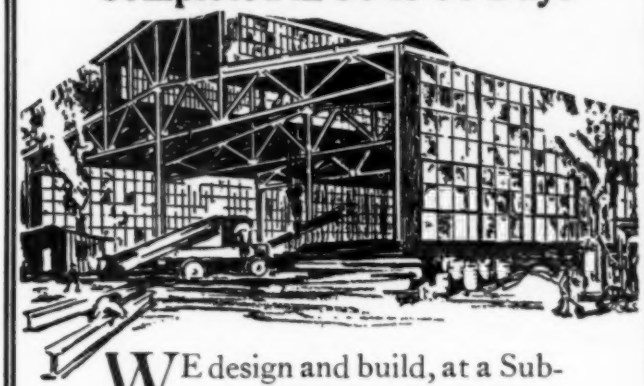

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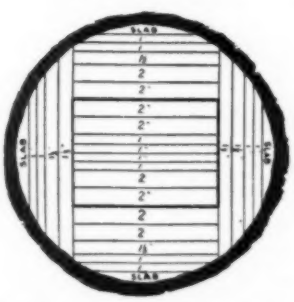

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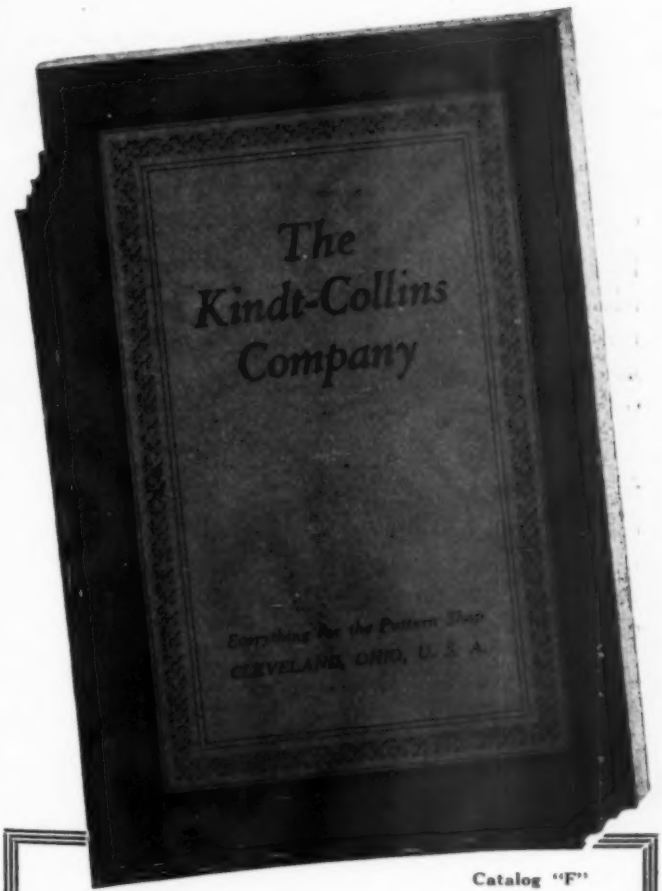

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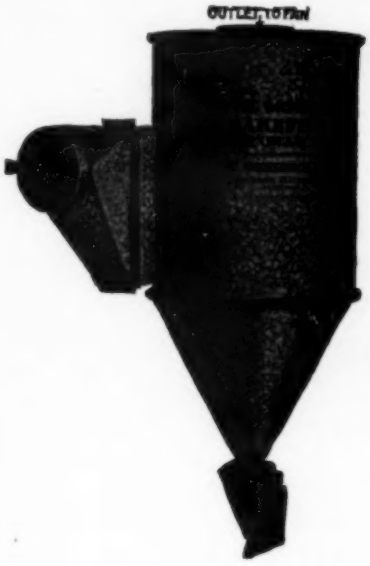

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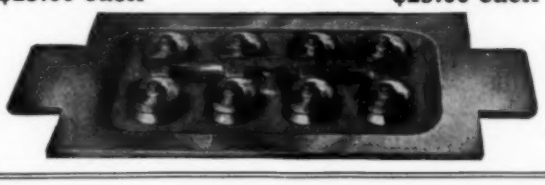

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SAND BLAST SHOT (Steel)—See SHOT (Steel Sand Blast)

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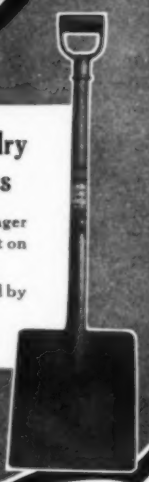

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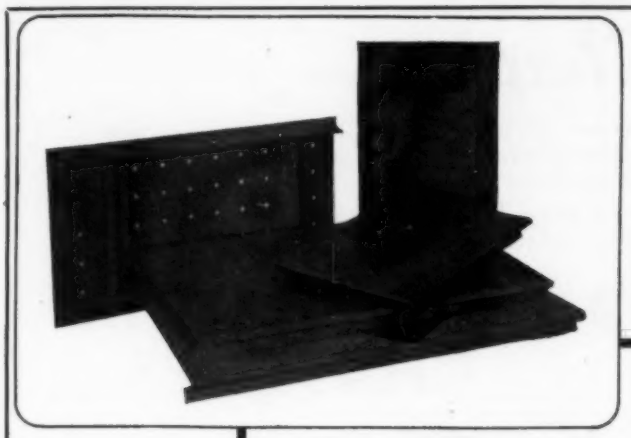

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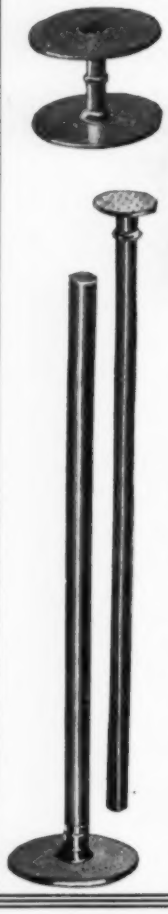

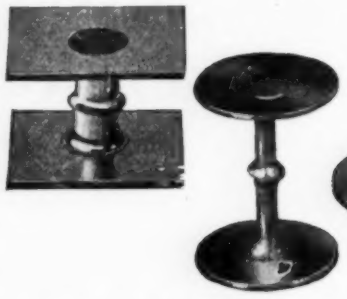

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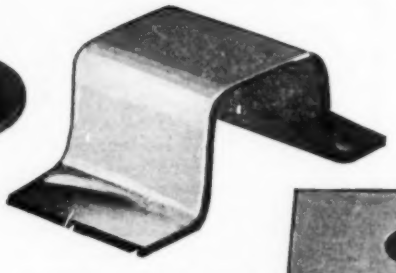

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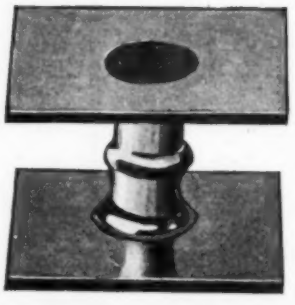

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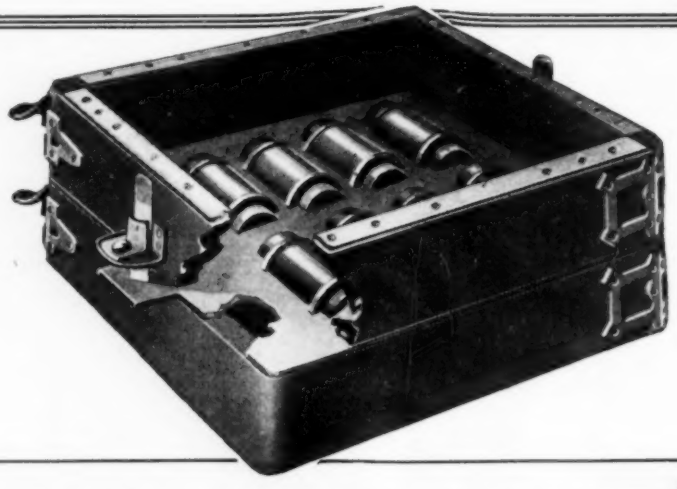

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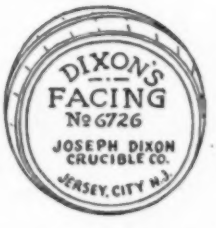
United Compound Co.
Buffalo, New York



Dixon's Graphite Facings

make Smooth Clean Castings doubly Sure

Use ***Dixon's Graphite Facings*** and your castings will no longer come out rough and scabby—you will have smooth, clean castings right along and will ***save a lot of costly cleaning and machining.***

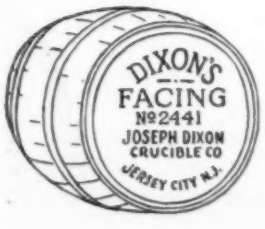
Dixon's Facings are made in grades especially suitable for every class of molding, green or dry sand, floor or bench work. They slick easily and do not run ahead of the metal.

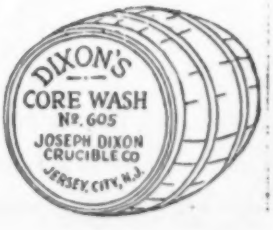
Let us send you samples so that you can put them to the test.

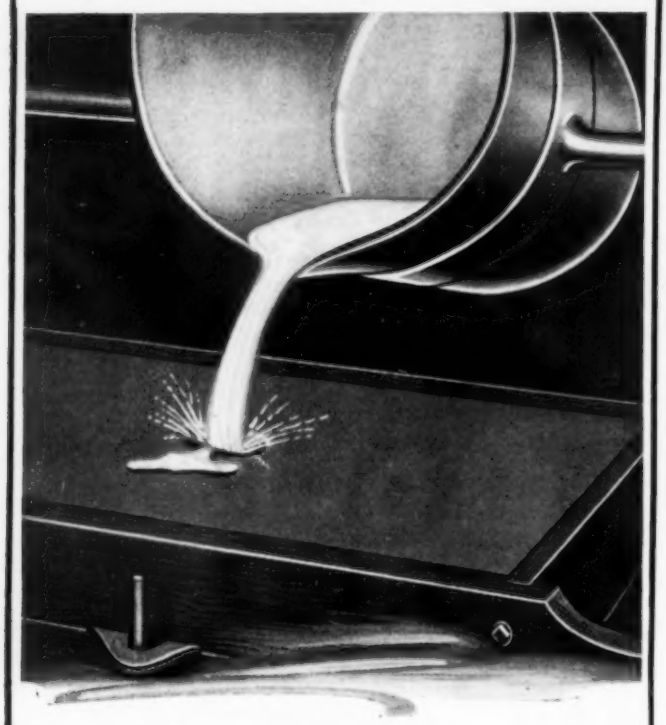
Made in JERSEY CITY, N. J. by the

Joseph Dixon Crucible Company

Established 1827







A Safe Mold
for Quality Steel

THERE are no sulphur derivatives in Core-Mol to contaminate your steel. Core-Mol isn't merely molasses either. It is *desugared* molasses with a special concentration of gum content for binding purposes. Wonderfully efficient, economical, and stands indefinitely without fermentation. Gaining use in foundries daily. Write for prices.

Mifflin Chemical Corporation
Philadelphia, Pa.
New York Warehouse, 527 Hudson Street

CORE-MOL
A MOLASSES BINDER

Order a trial barrel from any leading foundry supply house

CORE PEFFER OIL
TRADE MARK

FOR BETTER CORES

Pliable, stands the heat of molten metal, and is sufficiently porous to give off the gas. Cores baked with it bake quickly and are hard to the center.

PEFFER OIL COMPANY
Kingston Station WILKES-BARRE, PA.

USE

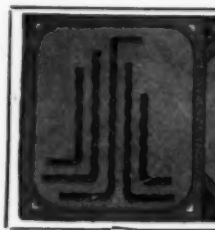
COROYL

IT'S RIGHT

IRON FILLERS **INVESTIGATE** MACHINE PAINTS

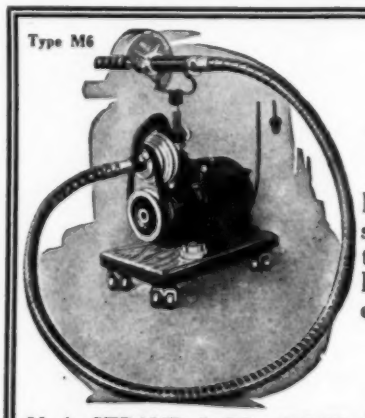
"LIN-O-CORE" OIL

"THE PIONEER CORE OIL"
Write for "Core Oil Treatise"
THOMPSON & COMPANY, PITTSBURGH, PA.



FRANKLIN GAGGERS
OF SQUARE TWISTED STEEL
consists of a solid body of metal insuring repeated use. Made in all standard sizes. Single or double bend.
FRANKLIN CORE ROD & GAGGER CO.
FRANKLIN, PA.

Type M6



Strand
TRADE MARK

THE FOUNDRY HELPER

No other Grinders made so convenient and easy to handle. Get in those hard places where no other grinder can.

Made in several types and sizes.

Agencies
All Principal Cities of the World

N. A. STRAND & CO., 625 W. Jackson Blvd., CHICAGO

Fifty-Fifty for Progress

DEMAND is largely a created thing. The actual needs of humanity are only a fraction of the general demand. It is always a simple matter to get along with less than one would like to have. When the public gets a streak of economy it curtails the demand for everything that is produced.

Advertising is a prime mover in creating business. It rouses people out of lethargy, makes them want to live more fully, and to possess the means of living more comfortably and more enjoyably.

When sales are hard to get, then most people who have things for sale increase their efforts to sell. The harder they try to sell, the harder their competitors try to sell. But no amount of selling effort—in the usual sense of the word—can create demand; it can only take advantage of the demand that has been otherwise created.

Advertising and Selling ought to be considered as "fifty-fifty" in importance. Advertising creates the consumer demand Selling connects this demand with the supply. Each needs the other to make its work complete.

Published by THE FOUNDRY in co-operation with The American Association of Advertising Agencies

USE THE RED ELECTRIC VIBRATOR AND INCREASE PRODUCTION

No 1 Vibrator $10.00. Wt. 1⅞ lbs.—For light match plate work.
No 2 Vibrator $13.00. Wt. 2¾ lbs.—For medium match plate work.
No 4 Vibrator $17.00 Wt. 4½ lbs.—For heavy match plate work, also for bench and tub.
No 8 Vibrator $21.00 Wt. 7¼ lbs.—Machine vibrator No cable furnished with this vibrator
Knee Switch $ 3.00

Order from your Foundry Supply House Today

When Ordering Please Give Accurate Voltage (A. C. only)
Manufactured by FOUNDRY SUPPLIES MFG. CO., Chicago, Ill.
2221 Orchard Street

CABLE 6 FT. LONG

CLEVELAND SAND RAMMERS
FOR FLOOR — FLASK AND BENCH RAMMING

For Speed—Power—Efficiency and Economy they have no equal. The men like them as they have no "Recoil" and when running "lift" and "carry" their own weight. Try one and note their resiliency on the work.

CLEVELAND CHIPPING HAMMERS are speedy and efficient Tools. They operate without any "Recoil" and are easy to hold on the work. They are "Ideal" Foundry tools as they are dust proof.

BOWES AIR HOSE COUPLINGS AND CLECO PRESSURE — SEATED AIR VALVES Are Standard Equipment Everywhere

Instantly Connected or Disconnected. Absolutely air tight under all pressures. Attached to Hose with Never Slip Clamps.

Write for Bulletins No. 51-52

THE CLEVELAND PNEUMATIC TOOL CO.
CLEVELAND, O., U. S. A.
Offices in all the large cities

THE "BRANFORD" VIBRATOR CORE BENCH

An all metal bench, lightly but strongly built.

A frame carrying a spring supported platen is located in the center of the bench near the forward edge.

Attached to the under surface of the platen is a "BRANFORD" Pneumatic Vibrator of a size sufficient to thoroughly vibrate the platen when in operation.

The controlling valve of the vibrator is so constructed that a slight downward pressure on the platen opens the valve and starts the vibrator.

The operator, having made the core, presses down on the core box, starting the vibrator and getting the necessary vibration to free the core from the box.

The vibrator platen can be furnished for benches already installed in your core shop.

Improving business means increasing production. By using the "BRANFORD" VIBRATOR CORE BENCH production is increased, core breakage and sprung core boxes are eliminated.

Write For Full Details

MALLEABLE IRON FITTINGS CO.

Vibrator Dept. **BRANFORD, CONN.**

Distributors:

Buckeye Products Co., Cincinnati; Combined Supply & Equipment Co., Buffalo; Freeman Supply Co., Toledo, O., Dayton Molding Machine Co., Dayton; Donald Mfg. & Supply Co., Milwaukee; Dominion Foundry Supply Co., Montreal, Que. and Toronto, Ont.; Foundrymen's Supply Co. Milwaukee; T. P. Kelly & Co., Inc., New York, Philadelphia, Pa., Worcester, Mass., Hamilton, O., Chicago, Ill.; Federal Steel Co., Detroit; New York Sand & Facing Co., Brooklyn, N.Y.; Jacob Shannon & Co., Philadelphia; Snow & Galgiani, San Francisco; Snyder & Campbell, 1926 Sacramento St., Los Angeles, Cal.; Whitehead Bros. Co., Providence, Buffalo; E. J. Woodison Co., Boston, St. Louis, Cleveland, Buffalo, New York, Detroit, Philadelphia, Pa.; Milwaukee, Wis.; Seattle, Wash.; Montreal, Que., Windsor, Ont.; F. B. Stevens, Detroit, Mich., New Haven, Conn., Indianapolis, Ind., Erie, Pa., and Windsor, Ont., Canada; Industrial Trade Corporation, First National Bank Building, Williamsport, Pa.; J. W. Paxson Co., Philadelphia, Pa. and Providence, R. I.

The Powell Blow-Gun Air Valve

IF YOU USE COMPRESSED AIR IN YOUR FOUNDRY

Write for Descriptive Information

Suction Tip

THE WM. POWELL CO.

2527 SPRING GROVE AVENUE
CINCINNATI, OHIO

The New Suction Tip

attached to a POWELL BLOW GUN AIR VALVE will remove every loose particle of sand and dirt from the bottom of molds. Saves time and labor in cleaning inaccessible places.

Cuts Costs
Makes Smoother Castings

Clouds of **DUST** *cause Inefficiency and Waste and Sap Health and Life*

Light, Clean Working Conditions

DUST ELIMINATION

from your
Sand Blasts Tumbling Barrels
Emery Stands Crushing Machines

Put Your Dust Problems squarely up to us, Guaranteed Service

The Northern Blower Co., Cleveland, O.

Foundry Equipment and Dust Collecting Engineers.

OLDHAM CHIPPERS

Are Standard in the Country's Largest Foundries

Type A

OLDHAM PNEUMATIC TOOLS

WRITE FOR CIRCULAR NO. 106
Sand Rammers, Core Busters, Scalers

Type B

GEORGE OLDHAM & SON COMPANY

BALTIMORE, MARYLAND

BOSTON DETROIT MONTPELIER PHILADELPHIA ST. CLOUD
CHICAGO MILWAUKEE NEW YORK PITTSBURGH ST. LOUIS

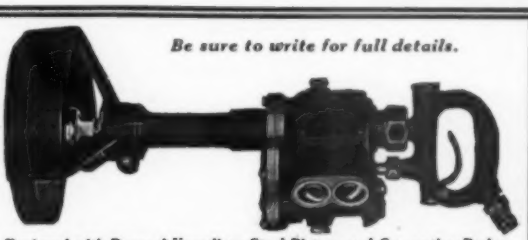
Alexander Wilson, Aberdeen Alfred Herbert, Ltd., Yokohama E. Garfield Andrews, Sydney

Thor

PORTABLE GRINDERS

These machines are of the reciprocating piston type, having four pistons direct acting on the crank shaft. CORLISS Valves with short and equal air travel for all cylinders, and large air chamber between cylinders insure an even, smooth-running machine with *great power and speed*. The air chamber has a *release valve* which opens automatically when throttle is closed, relieving the vacuum and allowing the wheel to stop gradually and without jerk.

Be sure to write for full details.



Equipped with Pressed Vanadium Steel Pistons and Connecting Rods. Pressed steel is also used in the spindle support and wheel guard and a combination of pressed steel and bar stock in the throttle. These features account for the *extreme lightness* with even greater durability than with materials generally used.

INDEPENDENT PNEUMATIC TOOL COMPANY

600 W. Jackson Blvd., CHICAGO, ILL.

New York Cleveland Pittsburgh Detroit Birmingham Philadelphia
San Francisco St. Louis Montreal Toronto Boston

CANTON PNEUMATIC TOOLS

The last word in Power and Speed.

Foundrymen like *Canton Tools* because they are fast workers and give an unusually long period of unfailing service.

Parts are few in number and substantial in construction. Maintenance cost is negligible.

Chipping Hammers; Calking Hammers; Beading Hammers; Hand Riveters; Core Breakers; Bench and Floor Rammers; Canton Valveless Chipping Hammers.

Send for catalog.

THE CANTON PNEUMATIC TOOL CO.

422 Schroyer Ave. *Successors to The Pittsburgh Pneumatic Tool Co.* Canton, Ohio

SALES OFFICES

Cleveland: 640 Guardian Bldg. Pittsburgh: 207 Frick Bldg. New York: 27 Warren St Los Angeles: 609 Wesley Roberts Bldg. Chicago: 106 S. Jefferson St.
Philadelphia: 1220 Real Estate Trust Bldg.

A Little Goes A Long Way!

One ton of

GLOBE H. C. CHILLED SHOT

can clean more castings quicker and better than from 50 to 100 tons of sand

It does not pulverize or go to dust as sand does —and it leaves the blasted surface clean.

Globe H. C. Chilled Shot will greatly reduce freight and handling costs of blasting abrasives.

It eliminates large storage bins and sand driers.

Globe H. C. Chilled Shot eliminates the dust from the sand blast room and provides pleasant working conditions which are an aid to production.

Write for samples.

The Globe Iron-Crush & Shot Co.
(Formerly THE GLOBE STEEL CO.)
Dept "F" Mansfield, Ohio

STANDARD —for Faster Cleaning

"Radial Blast"
SAND BLAST BARREL

The absence of internal blast mechanism permits the "STANDARD" to operate effectively when three quarters full—and *clean more castings in less time.* Four sizes, 24"—36"—48"—60" inside diameter.

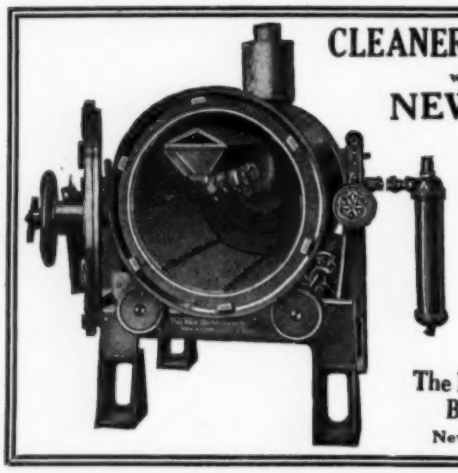
May we send full details?

The Standard Equipment Co.
New Haven, Conn.

DUSTLESS SELF-CONTAINED HOEVEL SANDBLAST AUTOMATIC MACHINES

Efficient Economical Dustless
Every Kind of Sandblast Equipment
Revolving Barrel Machines, Rotary Table Machines, Hose Sandblast, Dustless Sandblast Rooms, etc.

Hoevel Manufacturing Corporation
156 Ogden Ave., Jersey City, N. J.
Controlled by
L. O. Koven & Brother
Cleveland Office: 501 Ulmer Bldg.



CLEANER CASTINGS with NEW HAVEN Sand-Blast Equipment

THE MODEL 'A' is the Reliable, Proven and Practical Sand-Blast Barrel

The New Haven Sand Blast Company
New Haven, Conn.

PHILLIPS & McLAREN CO.

We manufacture

Grinding Pans

of all types and sizes for Steel, Gray Iron and Malleable Foundries.

24th and Smallman Sts., Pittsburgh, Pa.

Use Henderson Tumbling Barrels and Get 100% Results

A request will bring Circular

THE HENDERSON BROS. CO.
137 South Leonard St.
WATERBURY, CONN.

Mica Schist

Will save you 200% over any other refractory For furnace linings.

Edge Hill Silica Rock Co.
New Brunswick N.J.

Sand Blast Equipment and Accessories

The Tilghman-Brooksbank Sand Blast Company
1126 South 11th St. Philadelphia, Pa.

SPENCER
Turbo-Compressors

Inlet End No. 1050
Turbo-Compressor

"Spencer" Dependability Eliminates Delay

Delays caused by breakdowns and failures in air pressure, though costly, are practically unnecessary. Due to extremely wide clearances between all stationary and moving elements, and to the absence of gears or belts, the **Spencer Turbo-Compressor** maintains its efficiency permanently. It is sturdy and rugged, and thoroly reliable.

Dependability and Service are "built-in" qualities of the **Spencer Turbo-Compressor**. Over fifteen years experience in the design and manufacture of turbine compressors has placed the **"Spencer"** in the foreground of the industry.

Spencer Turbo-Compressors operate at low speed and furnish constant pressure free from surgings or pulsations.

Solve your problem the "Spencer" way.

The Spencer Turbine Company
Hartford, Conn.

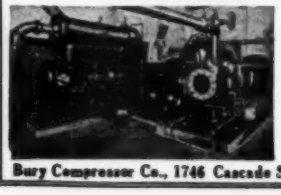
GARDNER

Pumps --- Governors --- Compressors

Because for more than 60 years Gardner machinery has been *better built machinery* it is today "the standard" wherever better pumps, compressors and governors are needed.

THE GARDNER GOVERNOR COMPANY
Quincy, Illinois
Chicago New York Philadelphia San Francisco Los Angeles

ULTIMATELY A BURY "UNIVERSAL" VARIABLE VOLUME, 3-CYLINDER 2-STAGE AIR COMPRESSOR. WHY NOT INSTALL ONE NOW?



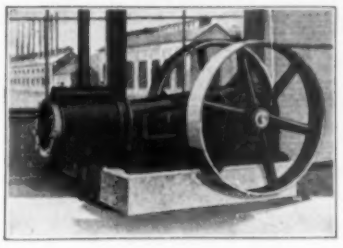
Durable as the Pyramids

Silent as the Sphinx

All Sizes
All Types
All Pressure
For All Requirements

Bury Compressor Co., 1746 Cascade St., Erie, Pa., U. S. A.

PENNSYLVANIA



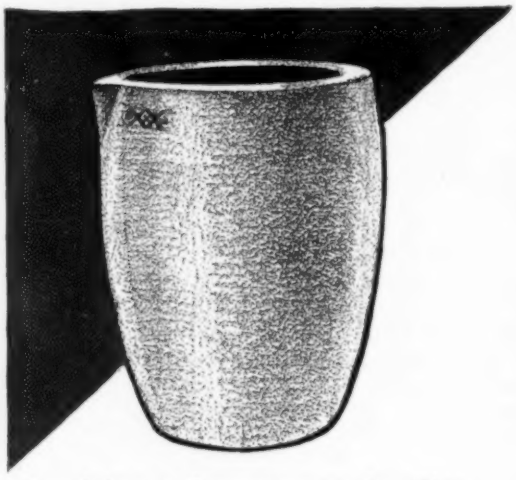
The main frame covers on Pennsylvania Air Compressors are aluminum castings, light, durable and oil tight. Many other valuable features are described in Bulletin No. 102, such as:

Removable Phosphor Bronze Main Bearings. Connecting rod having solid eyes both ends.

Inlet and discharge valves complete duplicate.

Wheel hubs taper fit on crank shaft, true running and easily removable.

PENNSYLVANIA PUMP AND COMPRESSOR COMPANY
MAIN OFFICES AND WORKS EASTON, PA.



A Guarantee Against Crucible Failure

Dixon Crucibles are time-tested and have proved that they can be depended upon to withstand an unusually large number of heats under the most trying conditions.

DIXON GRAPHITE CRUCIBLES

It needs but a trial to convince you that Dixon Crucibles—*the fruit of 92 years' experience*—are uniform in composition and construction, and remarkably efficient and economical in performance.

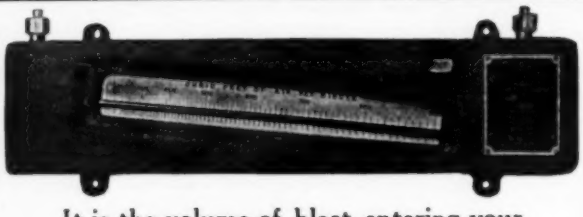
There's a "Dixon" for Every Metallurgical Requirement.

Write for catalog No. 51-A and get full particulars

JOSEPH DIXON CRUCIBLE COMPANY

Jersey City, N. J.

Established 1827



It is the volume of blast entering your furnace, not the pressure, that controls furnace operations.

The Clark Blast Meter indicates the Volume.

Booklet cheerfully sent—write for it

CHAS. J. CLARK BLAST METER CO., GLADBROOK IOWA

Westinghouse Traction Brake Co.

Industrial Air Compressors in all types and sizes

General Offices and Works:

WILMERDING, PA.

Pneumatic Tools **Turbo Blowers**
Air Compressors **Condensers**
Cameron Pumps

Ingersoll - Rand Company

11 Broadway, New York —M

The Best Tool for a Big Job

An axe in the hands of a crazy man is a serious menace, yet we do not condemn the axe for its wild or foolish application.

Advertising can be—has been—sometimes misused. Like all great forces, it must be intelligently planned and directed.

In the big job of reviving American business, advertising is the best tool that money can buy. Let's use it—boldly and well!

Published by THE FOUNDRY in co-operation with The American Association of Advertising Agencies

Fire Clay is obsolete as a bond

in high temperature furnaces

Modern efficiency calls for a fire mortar that is much more efficient and durable than Fire Clay. The solution to this problem is

MACK H. T.

HIGH TEMPERATURE FIRE BRICK

Bonding Cement

MACK H-T Cement sets up hard without heat, and instead of disintegrating or crumbling under heat as fire clay does, it welds the bricks together thereby assuring a permanent bond under all temperatures.

for
BOILER SETTINGS
FURNACE LININGS
CUPOLAS

for
LADLES, RETORTS
AND OPEN FLAME
FURNACES

MACK H-T Cement resists the abrasive action of flames and is not swept out of the seams by high velocity gases in oil furnaces. It is your insurance of gas tight walls.

Try it now and you'll always use it.

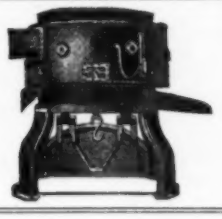
Mack Engineering and Supply Company, Inc.

161 Greenwich Street **New York City**

NEWTEN CUPOLA

FOURTEEN SIZES

NORTHERN ENGINEERING WORKS
218 CHENE ST. DETROIT, MICH.

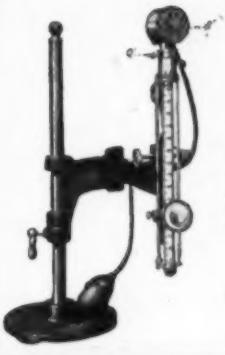


ELECTRIC FURNACES

"GREAVES-ETCHELLS" for melting and refining Iron and Steel.
FAST MELTING ACID LINED FURNACES.
ELECTRICALLY HEATED:—Core and Mold Drying Ovens. Vitreous Enameling and Japanning Ovens.
HEAT TREATING FURNACES for brass, iron and steel.

ELECTRIC FURNACE CONSTRUCTION CO.
908 Chestnut St., Philadelphia, Pa.

HARDNESS TESTING



with the Scleroscope gives you the advantage over your competitors. Our *booklet* on the Science and Testing of metals will be sent free on request.

HEAT INDICATIONS

In the foundry are now most successfully made with the Pyroscope. Inexpensive, simple, etc.

Pamphlet free

The Shore Instrument & Mfg. Co., Inc.
Van Wyck Ave. and Carll St., JAMAICA, N. Y.

SAVE MONEY

Control the Blast

The New **P-V** (Pressure) (Volume)

Recorder

will give you perfect control of the cupola and its output.

Write for details

Bacharach Industrial Instrument Co.
7000-06 Bennett St. Pittsburgh, Pa.

BOOTH

Booth Rotating furnaces for brass melting and melting of cast iron borings.

Booth Direct arc furnaces for steel and iron melting and refining of steel.

Booth Laboratory furnaces.

Furnaces in all sizes from 1 lb. to 20000 lbs. capacity.

The Booth Electric Furnace Co.
411 North Wells Street
Chicago, Ill.

TROUBLE FINDING LABOR?

To Handle Coal?
To Handfire Furnaces?
To Wheel Out Ash and Clinkers?

HOLBECK'S NEW METHOD *FUEL SYSTEM*

Founded on 15 years' experience.

Takes the coal from the car, distributes and burns it in the furnace. No late heats. High grade iron. Less furnace repairs. Don't worry about labor, write Austin A. Holbeck.

THE HOLBECK ENGINEERING CO.
MARSHALL BLDG. CLEVELAND, O.

Complete Installations
of Porcelain Enameling Plants

From plans to the plant in operation Pemco service is complete.

Even to the thorough training of employees nothing is left to chance or for you to find out for yourself.

This sort of superior service is the reason for 28 successful plants now in operation.

May we send our representative to explain our methods?

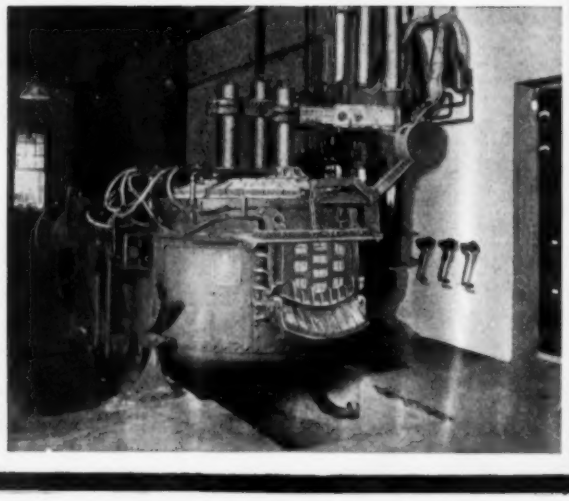
Porcelain Enamel & Mfg. Co.
Baltimore Maryland

PEMCO

MOORE RAPID 'LECTROMELT FURNACES

'Lectromelt

Simplicity and Ruggedness of design Characterize the *'Lectromelt* Furnace

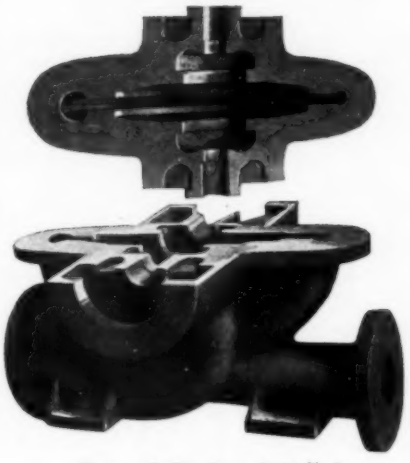


There is no complicated operating mechanism—all parts subjected to great wear and strain are made strong and durable by the use of the best material obtainable and by the practice of the most careful design.

Our catalogue describes all of these features and many others in complete detail—send for your copy today.

Pittsburgh Electric Furnace Corporation
Pittsburgh, Penna.

Melting Brass for High Grade Castings



Brass Cylinders (610 lb.)

Brass castings, which require metal of the closest analysis and represent the closest control over melting conditions, are universally produced in Baily Electric Furnaces.

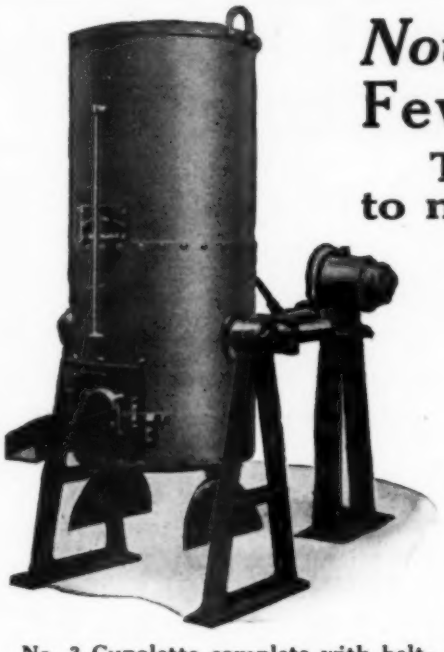
Practically the whole range of non ferrous metals is being handled-copper, all the red and yellow mixtures, also zinc and aluminum. More Baily units are installed in foundries than any other type of electric furnace.

We should like to describe the type best suited to the needs of your foundry.

THE ELECTRIC FURNACE COMPANY

Manufacturers of Baily Electric Furnaces

Wilson St. and P. R. R. Salem, Ohio



No. 3 Cupolette complete with belt-driven fan—Motor drive may be substituted

Now, When You Want a Few Castings in a Hurry—

This cupola plant will enable you to make them *at a profit.*

Designed for emergency or temporary use, during relining or breakdown of cupola. Increases your output. Helps to get out small rush jobs. Just the thing for experimental work.

Three Standard Sizes

Size	Melting Capacity Per Hour Pounds	Kilograms
No. 1	1120	508
No. 2	1680	762
No. 3	2800	1269

We also make

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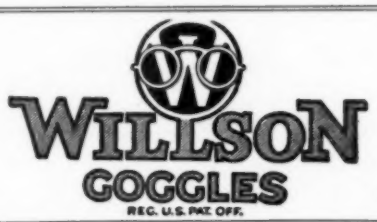

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WANTED:—A MECHANICAL ENGINEER who can handle men and supervise the installation of special machinery for the foundry; to act as field representative of our engineering department. We want a man who can take the bugs out of new machinery and who has had actual experience on the board designing foundry equipment. All replies will be considered confidential, give experience in detail and salary expected. Address Box 937, THE FOUNDRY, Cleveland.

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PRACTICAL GRAY IRON
FOUNDRY FOREMAN

Experienced on light work. Open shop. Northern Illinois district. State class of work you have handled and your experience in setting piece work prices. Number and nationality of men you supervised. Also state make of molding machines you are most familiar with. Give names of employers and positions held for past ten years; reasons for change and salary received. State your age, whether married or single, and salary desired. To man who qualifies this is an exceptional opportunity. Address Box 878, THE FOUNDRY, Cleveland, O.

WANTED:—METALLURGIST WITH MAture experience in the melting and casting of nickel-chromium alloys. Excellent opportunity with an established concern. Address Box 865, THE FOUNDRY, Cleveland, O.

THOROUGHLY COMPETENT IRON pattern filer for radiator foundry. One who can gauge up patterns, core boxes, molding machines, etc. State experience, age, wages wanted. Address Box 875, THE FOUNDRY, Cleveland, O.

Help Wanted

CUPOLA TENDER:—MAN WHO UNderstands lining and operating Whiting or Pawson Cupola. State experience and wages wanted. Address Box 876, THE FOUNDRY, Cleveland, O.

WANTED:—MASTER MECHANIC FOR large steel foundry; must be familiar with the repair and maintenance of electric traveling cranes, conveying equipment, locomotives, locomotive cranes, power plant equipment, etc. State age, experience, salary expected, and when available. Address Box 918, THE FOUNDRY, Cleveland.

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Help Wanted

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FOREMAN FOR MOLDING MACHINE Floor in Bronze Foundry. Must be able to produce accurate small and medium sized work. Address Box 921, THE FOUNDRY, Cleveland.

EXECUTIVES: — FOUNDRY SUPERINtendents, Foremen and other qualified men find our effective and confidential service extremely satisfactory when seeking new positions. Inquiries invited. THE NATIONAL BUSINESS BOURSE, Inc., H. H. Harrison, Pres., Confidential Negotiators, Association Building, Chicago.

WANTED:—SALESMAN FOR GRAY iron foundry in St. Louis district. McLain graduate preferred. Must be a business-getter. State salary and experience. Address Box 928, THE FOUNDRY, Cleveland.

FOUNDRY SUPERINTENDENT WANTed by a growing southern Michigan concern making gray iron and semi-steel castings. Want fairly young man who is willing to grow with us. McLain graduate. State salary and experience. Present foundry 180 x 80 feet; expect to increase to 450 feet long. Address Box 929, THE FOUNDRY, Cleveland.

WANTED:—McLAIN GRADUATE FOR foundry foreman by firm in south eastern Pennsylvania. Must be well-versed in chilled castings for small work, such as caster frames and bases. State age, experience and salary expected in first letter. Address Box 930, THE FOUNDRY, Cleveland.

Positions Wanted

SUPERINTENDENT OR GENERAL foreman by young man. Thoroughly familiar with heavy or light gray iron and semi-steel castings. Molding machine expert; also cupola practice. A-1 reference. Address Box 922 THE FOUNDRY, Cleveland.

THOROUGHLY EXPERIENCED CHEMist, metallurgist, roll maker, desires position with supervision over production of steel or gray iron castings, iron and steel rolls of every description, heat treatment. Scientific methods. Will consider a selling proposition. Age 42. Married, steady and reliable. Address Box 887, THE FOUNDRY, Cleveland.

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POSITION WANTED AS STEEL FOUNDry superintendent, by practical foundryman, and electric furnace melter, age 33, married. With college education. A-1 references. Address Box 888, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS CORE ROOM foreman. 15 years experience in gray iron foundry. Would like to connect with established concern. Age 31. Married. Address Box 913, THE FOUNDRY, Cleveland.

BOOKKEEPER AND ACCOUNTANT, thoroughly experienced in factory and foundry accounting, desires position in New England States or close by. Age 37, married. Highest reference. Address Box 914, THE FOUNDRY, Cleveland.

YOUNG BRASS FOUNDRY SUPERINtendent, at present employed, desires to make new connection with greater possibilities. Experienced on jobbing and production. Good cost man. Address Box 907, THE FOUNDRY, Cleveland.

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WANTED:—POSITION AS FOREMAN by young foundryman, in gray iron or steel foundry. Practical experience in all departments of foundry. Electric melter. Address Box 935, THE FOUNDRY, Cleveland.

ELECTRIC FURNACE MELTER, NOW employed, desires new connection. Experienced on basic or acid process, large and small castings. Practical man and well recommended. Address Box 936, THE FOUNDRY, Cleveland.

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METALLURGIST AND CHEMIST:— Young man at present producing certified malleable desires to make a change. Address Box 881, THE FOUNDRY, Cleveland, O.

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Positions Wanted

FOUNDRY SUPERINTENDENT, PRACtical man, desires to make a change. 25 years on high grade gray iron and semi-steel. Large shop preferred. Address Box 403, THE FOUNDRY, Cleveland, O.

PRACTICAL BRASS FOUNDRYMAN DEsires position. 25 years experience in brass foundry practice. Have efficiency views, understand metals. Can handle help. Address Box 830, THE FOUNDRY, Cleveland, O.

POSITION WANTED:—GENERAL FOREman, thoroughly familiar with heavy and light steel castings. A practical man, familiar with every detail of modern steel foundry practice. 15 years experience as a foreman. Address Box 750, THE FOUNDRY, Cleveland, O.

STEEL FOUNDRY EXECUTIVE WITH long experience in all branches of the business will soon be open for a position as manager, works manager or sales manager. Address Box 877, THE FOUNDRY, Cleveland.

OPERATING MANAGER OR SUPERINtendent. Seventeen years experience in Gray Iron Foundry. Automobile Cylinder Expert; Up-to-date on Molding Machine Equipment. Correspondence solicited. Address Box 906, THE FOUNDRY, Cleveland.

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WANTED:—POSITION AS GRAY IRON foundry superintendent, assistant superintendent or metallurgist by young man with college education and several years experience along these lines with a very large foundry, having had complete control of all cupolas, mixing and melting, testing and research work. Also practical foundry work, as well as being assistant superintendent in other foundries. American, married. Address Box 910, THE FOUNDRY, Cleveland.

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WANTED:—POSITION MALLEABLE superintendent, thorough in all foundry methods. Can take care of iron troubles. Good reasons for wishing change. Best of reference. Address Box 932, THE FOUNDRY, Cleveland.

Positions Wanted

POSITION AS FOUNDRY FOREMAN. 24 years practical experience in dry and green sand, gray iron and semi-steel. McLain graduate. Address Box 898, THE FOUNDRY, Cleveland.

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Wanted

WANTED
10 to 15 Ton Electric Crane 40′ Span.
Modern equipment. State full particulars.
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EQUIPPED FOUNDRY, WITH TRACKage, for sale. If interested, would be pleased to give complete details by mail. Keith Furnace Co., Des Moines, Iowa.

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5344 lbs. ⅛" Double End ½" sq. 18 Ga. Plates Top and Bottom, Hot Tinned Chaplets.
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Dodge Brothers
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New Tropenas Two Ton Converter.
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Will Sell As a Complete Unit or
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1 No. 112 G. E. Cupola Blower Set.
Capacity of Blower 3200 cu. ft. against 16 oz. Motor 3-phase, 60-cycle, 220-volt. Machinery little used.

Whitehead & Kales,
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One 30" x 10" B. B. Portable Molding Machine.

One 2 wheel sulky 700 lbs. Geared Ladle.

One 2 wheel sulky 600 lbs. Counter-balanced Ladle.

The above material was purchased new and has never been used. JOSIAH ANSTICE & CO., INC., Foundry Division, Rochester, N. Y.

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MOLDING MACHINES

The following items are located in plants of original purchasers. Some of them are in your vicinity. We will be glad to arrange for your inspection.

	Herman, combination jar and rollover; jar 40" x 50", independent 40" x 74"	$950.00
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	International 20" x 24" by 8" Stripper	110.00
(2)	International 22" x 26" x 6" Strippers	105.00
	International 26" x 36" x 12" Stripper	85.00
	Grimes, 14" x 14" hand operated	155.00
	Mumford, 30" x 42" with an 8" cylinder	130.00
	Nicholls, No. 13-32 Model B closed, like new	275.00
	Osborne, "Little Wonder" Nos. 46, 46-J and 48, each	200.00
(5)	Osborne, 12" x 12" x 4" Strippers, each	55.00
(2)	Osborne, 12" x 22" Strippers, each	70.00
	Osborne, 18" x 26" Stripper	85.00
	Osborne, 22" x 30" Air Squeezer	155.00
	Osborne, 16" x 14" x 8", Drop Plate Stripper	65.00
(3)	Pridmore, 16" x 14" Hand Rollover, each	100.00
	Pridmore, 18" x 24" Hand Rollover	105.00
	Pridmore, 16" x 18" type D, Stripper	150.00
	Pridmore, 16" x 24" x 4" Stripper	150.00
	Pridmore, 12" x 18" plate Portable Rockover	105.00
	Pridmore, 12" x 22", plate Portable Rockover	100.00
(2)	Pridmore, 14" x 14", plate Portable Rockover	100.00
	Pridmore, 12" x 18", plate Portable Rockover	$105.00
(14)	Pridmore, 14" x 14", style H, Portable Rockover, each	100.00
	Pridmore, 48" x 48" x 8", double shaft	450.00
	Tabor, 36" x 48", shockless, jarring, cylinders 8" diameter, capacity 2,000 pounds	1,000.00
	Tabor, 24" x 48" shockless, jarring, rollover, pattern drawing..	875.00

We also invite your inquiries for good used Blowers, Compressors, Cranes, Cupolas, Furnaces, Ladles, Sand Blasts, Tumbling Barrels, etc.

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